(2)

INSTALLATION RESTORATION PROGRAM
PHASE II
CONFIRMATION/QUANTIFICATION
STAGE 1

REESE AIR FORCE BASE
LUBBOCK, TEXAS

Prepared by:

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April 1988

FINAL REPORT
(May 1986 to April 1988)

VOLUME I: TECHNICAL REPORT

Prepared for:

UNITED STATES AIR FORCE
Headquarters Air Training Command
Bioenvironmental Engineering
HQ ATC/SGPB
Randolph AFB, Texas 78150-5001

UNITED STATES AIR FORCE
Occupational and Environmental Health Laboratory (USAFOEHL)
Technical Services Division (TS)
Brooks Air Force Base, Texas 78235-5501

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STAGE 1

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FOR
REESE AIR FORCE BASE
LUBBOCK, TEXAS

UNITED STATES AIR FORCE
HEADQUARTERS AIR TRAINING COMMAND
BIOENVIRONMENTAL ENGINEERING
(HQ ATC/SGPB)
RANDOLPH AFB, TEXAS 78150-5001

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Ecology and Environment, Inc., was retained by the USAFOEHL/TSS to provide technical and analytical services in support of the Air Force IRP. These services were applied to the Phase II, Stage 1, investigation of Reese AFB, Lubbock, Texas. The field investigation was conducted from June 24, 1986 to October 31, 1986, and involved work at nine areas at the base. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils, groundwater and surface water. Samples were analyzed for various parameters including volatile organics, oil and grease, pesticides, herbicides, petroleum hydrocarbons, primary metals, phenols, PCBs, and polynuclear aromatic hydrocarbons. Results of the investigation indicated that past waste handling and disposal practices had caused various degrees of soil and groundwater contamination. Follow-up (Stage 2) work has been recommended at areas 001, 002, 004, 006, 008, and 009 to better define the extent of contamination. Areas 003, 005, and 007 were judged to require no follow-up action.

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PREFACE

The purpose of this two-volume report is to document the Phase II, Stage 1, investigation of the United States Air Force (USAF) Installation Restoration Program (IRP) at Reese Air Force Base, Lubbock, Texas. This work was conducted by Ecology and Environment, Inc., (E & E) under Contract No. F33615-83-D-4003, Task Order 11.

Mr. Gerald Strobel is Program Manager for this Contract. The Task Order was managed by Mr. Michael Benner. Laboratory analyses were accomplished at E & E's Analytical Services Center in Buffalo, New York, under the supervision of Mr. Andrew Clifton and Ms. Cathy Syracuse.

This work was accomplished during the period from June 24, 1986, to October 31, 1986. Mr. Dennis E. Lundquist, USAF, Technical Services Division, USAF Occupational and Environmental Health Laboratory (USAFOEHL/TS), was the Technical Program Manager.

Approved

Gerald Strobel

Gerald Strobel
Program Manager

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EXECUTIVE SUMMARY

Ecology and Environment, Inc., (E & E) was retained by the United States Air Force (USAF) Occupational and Environmental Health Laboratory (OEHL) under Contract No. F33615-83-D-4003, Task Order 11, to provide technical and analytical services in support of the Air Force Installation Restoration Program (IRP). This report concerns the Phase II Stage 1 investigation of Reese Air Force Base (AFB), Lubbock, Texas.

Reese AFB is located in the High Plains region of the Great Plains, adjacent to the western boundary of Lubbock, Texas. Reese AFB covers 2,777 acres (owned and leased) in Lubbock County, including acreage in the Hurlwood area, acquired in 1978. (See Section 1 for maps that show the regional location of Reese AFB, as well as the layout of the base.)

Throughout the history of Reese AFB, certain activities have had the potential to contribute to environmental contamination of the site, including the discharge of waste oils, solvents, detergents, and paint residues into the Industrial Waste Lake; the discharge of waste AVGAS, oils, lubricants, and miscellaneous combustible materials during fire training exercises; landfilling and land spreading of waste materials which may have included hazardous wastes and pesticides; accidental spills of aviation fuels; and the operation of two surface impoundments which are known to contain hazardous wastes. Many former waste disposal practices have been discontinued. At the time of this investigation, disposal practices included operation of a surface impoundment for some industrial shop operations; operation of a

surface impoundment for sewage treatment plant effluent; landfilling of domestic and construction wastes; and land spreading of Sewage Lake sludges.

The Phase I final report (June 1984, Radian Corporation) identified 36 sites; nine of which received a HARM score. The USAF reviewed the Phase I recommendations and contracted 14 sites to be investigated during Phase II. These 14 sites included the nine sites which received a HARM score and five additional sites. Figure 1 shows the locations of the 14 sites contracted by USAF for Phase II study. The 14 sites were regrouped into nine areas for ease of investigation and monitoring during Phase II Stage 1 work. Table 1 lists the regrouped areas that were investigated during Phase II.

SUMMARY OF FIELD PROGRAM

Fieldwork for the Phase II Stage I investigation at Reese AFB began June 23, 1986, and ended September 12, 1986. The program consisted of the following:

- Geophysical surveys of landfill areas in Areas 002, 004, 007, and 008;
- Collection of surface water samples from the Sewage Lake and the Industrial Waste Lake at Areas 001 and 002;
- Collection of groundwater samples from monitoring wells installed at Areas 001, 002, 004, and 005 and from existing wells at Area 007;
- Collection of soil samples from boreholes drilled at Areas 001 through 009 and collection of sediment samples from Areas 001, 002, and 006;
- Soil gas survey of former fuel spill area at Area 003; and
- Records review survey of existing wells located within a 1-mile radius of Reese AFB.

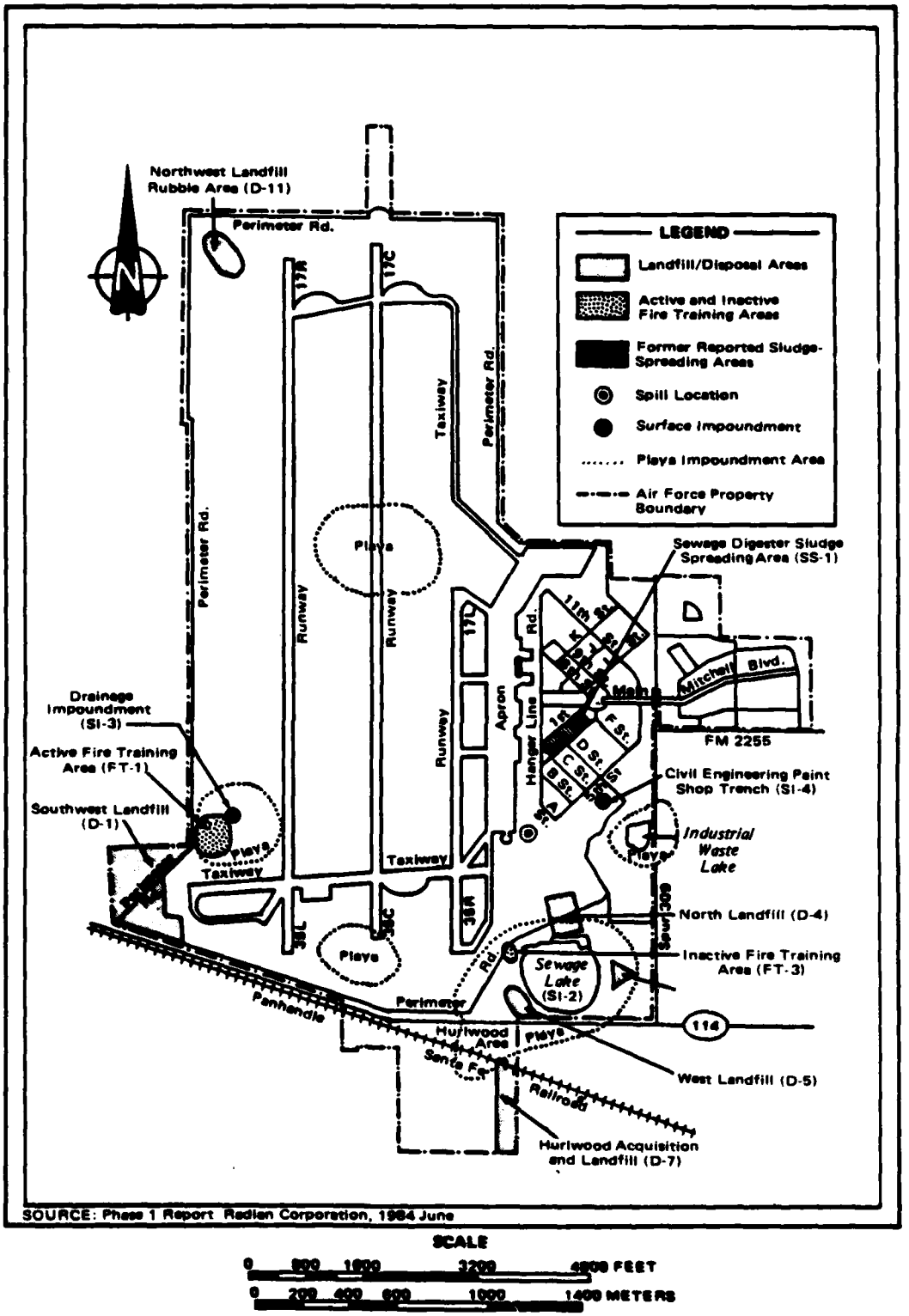

Figure 1 REESE AFB AREAS OF POTENTIAL ENVIRONMENTAL CONTAMINATION FROM PHASE I REPORT

Table 1

SUMMARY OF AREAS
PHASE II STAGE 1 INVESTIGATION

Area Number	Area Name	Phase I Designation	USAF Designation
Area 001	- Industrial Waste Water Lake[3]	SI-1	WP-01
Area 002	- Sewage Lake[1,3]	SI-2	WP-03
Area 003	- POL Storage Area (Aqua System) Spill Site[3]	SP-1	SS-01
Area 004	- Southwest Landfill[3]	D-1	LF-01
Area 005	- Civil Engineering Paint Shop Trench[3]	SI-4	OT-01
Area 006	- Active Fire Training Area[2,3]	FT-1	FT-01
Area 007	- Northwest Landfill/Rubble Area[3]	D-11	LF-02
Area 008	- Hurlwood Acquisition and Landfill	D-7	LF-03
Area 009	- Sewage Digester Sludge Spreading Area (between 1st and 2nd Streets)	SS-1	WP-02

[1]Includes: East Landfill (D-3), North Landfill (D-4)[3], West Landfill (D-5)[3], and Inactive Fire Training Area (FT-3).

[2]Includes: Drainage Impoundment (SI-3).

[3]Sites which received HARM score in Phase I report.

Table 2 summarizes the fieldwork completed at each Reese AFB site.

FINDINGS

The analytical results on groundwater and soil samples from the Phase II Stage 1 investigation suggest contamination from volatile solvents, phthalates, oil and grease, and metals. Results of groundwater analysis from monitoring wells on the base and at the Hurlwood acquisition indicated levels of volatile solvents and phthalates above the detection limits. Groundwater contamination did not exceed EPA primary or secondary drinking water standards. At one site, trichloroethene was found in the groundwater at concentrations of 41 and 24 ug/L (present MCL is 5 ug/L). The source of these solvents is unclear.

Results of soil analysis from the areas checked reveal the main soil contaminants to be oil, grease, and metals. Analysis of soil samples indicated a wide range of oil and grease levels with the maximum concentration being 4,500 mg/kg. Lead, chromium, zinc, copper, nickel, and arsenic were found in various soil samples from the areas checked. No correlation was determined between the depth from which the samples were collected and the associated metal concentrations.

Results of sediment analysis from the areas checked reveal the main sediment contaminants to be oil, grease, lead, and chromium. The maximum concentrations of oil and grease were found in sediments from the Industrial Waste Lake (SI-1). The maximum oil and grease concentration was 12,000 mg/kg. The sediments from the Industrial Waste Lake also contained quantifiable concentrations of volatile organic compounds and phthalates. Lead and chromium were found in sediment samples from the Sewage Lake (SI-2) and the Drainage Impoundment (SI-3). The maximum concentrations of lead and chromium were 11 mg/kg and 72 mg/kg, respectively.

The following discussions summarize the findings at each Area. Table 3 summarizes the analytical findings at each of the areas investigated.

Table 2

SUMMARY OF FIELDWORK/ANALYSES PERFORMED

Area	Fieldwork Performed*	Analysis Performed
Area 001 - Industrial Waste Lake (SI-1)	4 boreholes drilled; 1 borehole completed as a monitoring well; 23 soil samples and 7 water samples collected	Purgeable organics, oil and grease, phenols, BNA extractable organics, organochlorine pesticides and PCBs, organophosphorus pesticides, chlorinated herbicides, total dissolved solids, primary metals.
Area 002 - Sewage Lake (SI-2)	4 boreholes drilled; 1 borehole completed as a monitoring well; 16 soil samples and 6 water samples collected; geophysical survey	Oil and grease, phenols, purgeable organics. BNA extractable organics, organochlorine pesticides and PCBs, organophosphorus pesticides, chlorinated herbicides, total dissolved solids, primary metals.
Area 003 - POL Storage Area (Aqua System) Spill Site (SP-1)	4 boreholes drilled; 22 soil samples collected; soil gas survey	Purgeable organics, petroleum hydrocarbons, oil and grease, chromium, lead
Area 004 - Southwest Landfill (D-1)	4 boreholes drilled; 1 borehole completed as a monitoring well; 19 soil samples and 2 water samples collected; geophysical survey	Purgeable organics, oil and grease, organochlorine pesticides and PCBs, organophosphorus pesticides, chlorinated herbicides, primary metals, phenols, total dissolved solids, BNA extractable organics.
Area 005 - Civil Engineering Paint Shop Trench (SI-4)	1 borehole drilled and completed as a monitoring well; 4 soil samples and 4 water samples collected	Purgeable organics, oil and grease, phenols, BNA extractable organics, cadmium, chromium, lead, nickel, zinc, primary metals
Area 006 - Active Fire Training Area (FT-1)	4 boreholes drilled; 12 soil samples collected	Purgeable organics, oil and grease, phenols, chromium, lead
Area 007 - Northwest Landfill/Rubble Area (D-11)	4 boreholes drilled; 16 soil samples collected; geophysical survey	Purgeable organics, oil and grease, polynuclear aromatic hydrocarbons
Area 008 - Hurlwood Acquisition and Landfill (D-7)	2 boreholes drilled; 9 soil samples and 5 water samples collected; geophysical survey	Purgeable organics, oil and grease, phenols, arsenic, BNA extractable organics, primary metals
Area 009 - Sewage Digester Sludge Spreading Area (SS-1)	10 boreholes drilled; 22 soil samples collected	Purgeable organics, oil and grease, BNA extractable organics, arsenic, cadmium, lead, chrome, copper, nickel, zinc

* Soil and water sample totals include QA samples and drill cutting EP toxicity samples where applicable.

Table 3

ANALYTICAL FINDINGS

Area	Contaminant	Matrix	Concentration	Criteria
001-Industrial Waste Lake	Phthalates	Soil	ND-2.8 mg/kg	--
	Oil & Grease	Soil	530 mg/kg	100 mg/kg normal
	DDT	Soil	ND-3.2 ug/kg	--
	Oil & Grease	Sediment	ND-12,000 mg/kg	--
	Total xylenes	Sediment	ND-31,000 ug/kg	--
	Tetrachloroethene	Sediment	ND-13,000 ug/kg	--
	1,1,1-trichloroethane	Sediment	ND-3,000 ug/kg	--
	Trichloroethene	Sediment	ND-1,400 ug/kg	--
	Pyrene & Chrysene	Sediment	ND-3.2 ug/kg	--
	1,1,1-trichloroethane	Surface Water	.57-7.1 ug/L	200 ug/L[1]
	tetrachloroethene	Surface Water	1.7-15 ug/L	680 ug/L[2]
	Toluene	Ground Water	ND-3.9 ug/L	2,000 ug/L[4]
	1,1-dichloroethane	Ground Water	ND-0.18 ug/L	7 ug/L[1]
002-Sewage Lake	Oil & Grease	Soil	ND-200 mg/kg	--
	Oil & Grease	Sediment	ND-1,100 mg/kg	--
	DDD	Sediment	ND-3.1 ug/kg	--
	DDT	Sediment	ND-2.4 ug/kg	--
	Chlorpyrifos	Surface Water	ND-0.46 ug/L	--
	Malathion	Surface Water	ND-0.43 ug/L	
	Toluene	Surface Water	ND-1.5 ug/L	2,000 ug/L[4]
	1,4-dichlorobenzene	Surface Water	ND-1.1 ug/L	750 ug/L[1]
	Di-n-butyl phthalate	Surface Water	ND-14 ug/L	--
	Lead	Surface Water	ND-0.007 mg/L	--
	Zinc	Surface Water	ND-0.061 mg/L	--
	Bis (2-ethylhexyl) phthalate	Ground Water	93-160 ug/L	--
	Di-n-butyl phthalate	Ground Water	ND-36 ug/L	--
	Toluene	Ground Water	0.47-6.8 ug/L	2,000 ug/L[4]
	Lead	Ground Water	ND-0.007 mg/L	--
	Zinc	Ground Water	ND-0.071 mg/L	--

Table 3 (Cont.)

Area	Contaminant	Matrix	Concentration	Criteria
003-POL Storage Area	Lead	Soil	ND-8.3 mg/kg	--
	Oil & Grease	Soil	ND-230 mg/kg	--
	Chromium	Soil	5.9-17 mg/kg	--
	Petroleum Hydrocarbons	Soil	ND-110 mg/kg	--
004-Southwest Landfill	Copper	Soil	ND-8.5 mg/kg	--
	Chromium	Soil	ND-14 mg/kg	--
	Nickel	Soil	ND-13 mg/kg	--
	Zinc	Soil	8.8-36 mg/kg	--
	Lead	Soil	ND-8.3 mg/kg	--
	Oil & Grease	Soil	ND-160 mg/kg	--
	Phthalates	Ground Water	ND-80 ug/L	--
	Toluene	Ground Water	.88-3.2 ug/L	2,000 ug/L[4]
	Trichloroethene	Ground Water	24-41 ug/L	5 ug/L[5]
005-Civil Engineering Paint Trench	Oil & Grease	Ground Water	1.3-3.4 mg/L	--
	Toluene	Ground Water	1.2-2.2 ug/L	2,000 ug/L[4]
	Methylene Chloride	Ground Water	ND-6.6 ug/L	350 ug/L[2]
	Di-n-butyl Phthalate	Ground Water	10-24 ug/L	--
	Copper	Ground Water	ND-0.023 mg/L	1,000 ug/L[3]
	Lead	Ground Water	0.014-0.03 mg/L	50 ug/L[3]
	Zinc	Ground Water	0.20-0.36 ug/L	2,000 ug/L[3]
	Chromium	Soil	ND-10 mg/kg	--
	Lead	Soil	ND-7.2 mg/kg	--
	Zinc	Soil	10-21 mg/kg	--
006-Active Fire Training Area	Lead	Soil	ND-7.2 mg/kg	--
	Chromium	Soil	ND-72 mg/kg	--
	Oil & Grease	Soil	ND-190 mg/kg	--
	Oil & Grease	Sediment	ND-250 mg/kg	--
	Chromium	Sediment	17-18 mg/kg	--
	Lead	Sediment	13-16 mg/kg	--
007-Northwest Landfill	Oil & Grease	Soil	ND-1,500 mg/kg	--
008-Hurlwood Acquistion and Landfill	Arsenic	Soil	ND-7.8 mg/kg	--
	Toluene	Ground Water	ND-1 ug/L	2,000 ug/L[4]
	Di-n-butyl phthalate	Ground Water	ND-18 ug/L	--
	Oil & Grease	Ground Water	0.4-0.5 mg/L	--
	Lead	Ground Water	ND-0.038 mg/L	50 ug/L[3]
	Zinc	Ground Water	ND-2.9 mg/L	2,000 ug/L[3]

Table 3 (Cont.)

Area	Contaminant	Matrix	Concentration	Criteria
009-Sewage Digester Sludge Spreading Area	Oil & Grease	Soil	ND-4,500 mg/kg	--
	Phthalates	Soil	ND-8.6 ug/kg	--
	Chromium	Soil	7.4-15 mg/kg	--
	Copper	Soil	3.6-9.8 mg/kg	--
	Zinc	Soil	17-50 mg/kg; 2,500 mg/kg	--
	Nickel	Soil	ND-12 mg/kg	--
	Cadmium	Soil	ND-1.2 mg/kg	--
	Arsenic	Soil	ND-1.5 mg/kg	--

ND - Not detected above method detection limits.
1. RMCL (EPA, 1985a)
2. Lifetime Health Advisory (EPA, 1985c)
3. MCL (EPA, 1985c)
4. Proposed RMCL (EPA, 1985b)
5. Proposed MCL (EPA, 1985a)

Area 001 - Industrial Waste Lake

Soil contaminants consisted of levels of phthalates, oil and grease, and DDT above method detection limits. There are no standards available as upper bound limits for these parameters. Sediment contaminants consisted of oil and grease, total xylenes, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, pyrene, and chrysene. The presence of these wastes is consistent with wastes indigenous to airport operations (i.e., lubricants, cleaning solvents, etc.). Groundwater contaminants consisted of volatile solvents. Area 001 is not considered a serious environmental threat due to the low levels of contaminants in the soils, surface water, and groundwater; however, further study should be done to determine if a link exists between discharge to the lake and groundwater contamination. Due to the uncertainty of the source of groundwater contamination, Area 001 is deemed a Category II site.

Area 002 - Sewage Lake, Associated Landfills, and Fire Training Area

Soil contamination consisted of levels of oil and grease above the method detection limit of 100 mg/kg. There are no standards available as upper bound limits for these parameters. Pesticide levels were found in the lake sediment samples above method detection limits. There are no standards available as upper bound limits for these parameters. This contamination may have been associated with pest control operations on the golf course. Surface water contamination included levels of pesticides and organic solvents above detection limits but below current MCLs. These contaminants may have been associated with previous pest control operations on the golf course and the discharge of waters from the Industrial Waste Lake. Groundwater contaminants consisted of volatile solvents, phthalates, oil and grease, lead, and zinc. The groundwater contaminant levels were comparable to all other groundwater contaminant levels on the base.

While there are low levels of contamination, Landfills D-3, D-4, D-5, and SI-3 have not been fully investigated. Area 002 is considered a Category II area.

Area 003 - POL Storage Area

Analytical results of the soil samples collected at Area 003 indicated concentrations above method detection limits for oil and grease, chromium, and lead. There are no standards available for comparison as upper bound limits for these parameters. No correlation was found between the depths of the samples and the presence of metals.

Area 003 is not considered an environmental or health threat and is deemed a Category I site.

Area 004 - Southwest Landfill

The metals arsenic, copper, chromium, nickel, and zinc were detected in the soils. No correlation as to contaminant depth or source could be drawn from the analytical results. Groundwater contamination consisted of levels of organic solvents and phthalates above method detection limits, and except for one case, also above the EPA MCL. The presence of trichloroethene was confirmed at concentrations of 24 to 41 ug/L.

Area 004 is considered a Category II site due to the uncertainty of the source of trichloroethene and to the uncertainty of the extent of metals contamination.

Area 005 - Civil Engineering Paint Shop Trench

Groundwater contamination consisted of levels of volatile solvents, lead, zinc, copper, and phthalates above method detection limits but below EPA limits.

Area 005 is not considered an environmental or health threat. It is, therefore, considered a Category I site.

Area 006 - Active Fire Training Area

Concentrations of heavy metals and oil and grease were above method detection limits in the soil samples collected at Area 006. There are no standards available as upper bound limits for these parameters. No correlation was determined between depth of contamination and sample location.

Area 006 is considered a Category II site due to the uncertainty of the vertical and lateral extent of contamination.

Area 007 - Northwest Landfill

Soil contamination consisted of a single level of oil and grease above the method detection limit. Area 007 is not considered an environmental or health threat and is considered a Category I site.

Area 008 - Hurlwood Acquisition and Landfill

Soil contamination consisted of a single level of arsenic above the method detection limit. No correlation was found between contamination depth and sample location. The source of the arsenic was not determined.

Groundwater contaminants consisted of levels of phthalates and heavy metals above method detection limits but below EPA MCLs.

Area 008 is considered a Category II site due to the uncertainty of the arsenic source and the uncertainty of the vertical and lateral extent of arsenic contamination.

Area 009 - Sewage Digester Sludge Spreading Area

Soil contamination consisted of levels of oil and grease, phthalates, and heavy metals above the method detection limit. There are no standards available as upper bound limits for these parameters. No correlation was determined between contamination depth and sample location.

Area 009 is considered a Category II site due to the uncertainty of the vertical and lateral extent of contamination.

RECOMMENDATIONS

Based on the results of the Phase II Stage 1 investigation, Table 4 lists the recommendations and rationale for the recommendations for each of the areas. Recommendations for Category II sites outlined in Table 4 are listed in order of priority.

The POL Storage Area, Northwest Landfill, and the Civil Engineering Paint Trench should be considered Category I sites, since no further action is recommended due to the absence of any potential environmental hazard. The Southwest Landfill, Industrial Waste Lake, Sewage Lake, Active Fire Training Area, Sewage Digester Sludge Spreading Area, and the Hurlwood Acquisition landfill should be considered Category II sites, requiring additional sampling to further assess the extent of current or future contamination.

Table 4

SUMMARY OF RECOMMENDATIONS

Area	Recommendation	Rationale
004-Southwest Landfill (D-1)	Category II. Collect subsurface soil samples; collect groundwater samples from three or four wells; drill six additional boreholes and sample borehole sediments	To define background levels of groundwater contamination; to define level of groundwater contamination at Area 004; to define extent of inorganic contaminant migration in soils.
001-Industrial Waste Lake (SI-1)	Category II. Collect surface water samples, collect sediment samples. Install one downgradient well and collect groundwater samples.	To monitor discharges to the lake and correlate discharge with contaminant accumulations.
006-Active Fire Training Area (FT-1)	Category II. Collect sediment samples; drill six additional boreholes and sample borehole sediments.	To define the extent of the lead and chromium contamination.
009-Sewage Digester Sludge Spreading Area (SS-1)	Category II. Drill ten additional boreholes and sample borehole sediments.	To define vertical and lateral extent of metals contamination.
008-Hurlwood Acquisition and Landfill (D-7)	Category II. Drill three additional boreholes and sample borehole sediments.	To define source and extent of arsenic contamination.
002-Sewage Lake (SI-2)	Category II. Additional geophysical survey; install one upgradient well and collect groundwater samples; install one downgradient well and collect groundwater samples; drill additional boreholes and sample borehole sediments.	Minor contamination present in surface and groundwater, lake sediments, and soils.
003-POL Storage Area (SP-1)	Category I. No further action required.	Minor contamination present in soils; however, levels do not present an environmental or health concern.
005-Civil Engineering Paint Trench (SI-4)	Category I. No further action required.	Minor contamination present in soils and groundwater; however, levels do not present an environmental or health concern.
007-Northwest Landfill (D-11)	Category I. No further action required.	No significant contamination detected.

1. INTRODUCTION

The Installation Restoration Program (IRP) was initiated by the Department of Defense (DOD) to investigate environmental contamination that may be present at DOD facilities as a result of past operations and waste disposal activities. Following passage of the Resource Conservation and Recovery Act (RCRA) of 1976 and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 in June 1980. DEQPPM 80-6 mandated that hazardous waste disposal sites on DOD facilities be identified. The United States Air Force (USAF) implemented DEQPPM 80-6 in December 1980. DOD revised and expanded existing IRP directives through DEQPPM 81-5 in 1981, and the USAF implemented it in January 1982. The IRP has been developed as a four-phase program as follows:

- Phase I - Records Search;
- Phase II - Confirmation and Quantification;
- Phase III - Technology Base Development; and
- Phase IV - Corrective Action.

This report documents work performed by Ecology and Environment, Inc., (E & E), for the USAF at Reese Air Force Base (AFB), Lubbock, Texas. The work was done as part of Phase II, Stage I of the IRP under Contract No. F33615-83-D-4003, Task Order 11. The purpose of Phase II Stage I work was:

- To determine the presence or absence of contamination at specified areas;

- To define the magnitude and potential of contaminant migration, if possible; and

- To identify potential health and/or environmental hazards based on state or federal standards.

A Phase I Initial Records Search had been conducted from March 12 through March 16, 1984, by Radian Corporation. The Phase I Report identified areas with potential contamination problems for Phase II investigation. The USAF reviewed the Phase I recommendations, and contracted to have 14 sites investigated in Phase II. The 14 sites were regrouped into nine areas for ease of investigation and monitoring during Phase II Stage 1 work. The Phase II Stage 1 areas investigated were:

- Area 001: Industrial Waste Lake (SI-1*)

- Area 002: Sewage Lake (SI-2*), East Landfill (D-3*), North Landfill (D-4*), West Landfill (D-5*), and Inactive Fire Training Area (FT-3*);

- Area 003: POL Storage Area (Aquasystem) Spill Site (SP-1*);

- Area 004: Southwest Landfill (D-1*);

- Area 005: Civil Engineering Paint Shop Trench (SI-4*);

- Area 006: Active Fire Training Area (FT-1*) and Drainage Impoundment (SI-3*);

- Area 007: Northwest Landfill/Rubble Area (D-11*);

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*USAF designation

- Area 008: Hurlwood Acquisition and Landfill (D-7*); and

- Area 009: Sewage Digester Sludge Spreading Area (SS-1*).

A description of work for Phase II Stage I was developed and issued on February 24, 1986. The field investigation was performed in three stages from June 24, 1986 through October 31, 1986.

1.1 LOCATION AND HISTORY OF OPERATIONS

Reese AFB is located adjacent to the western boundary of Lubbock, Texas, in the High Plains region of the Great Plains (see Figures 1-1 and 1-2). The base covers 2,777 acres (owned and leased) in Lubbock County (see Figure 1-3). The land surrounding the base is primarily agricultural, except for the unincorporated community of Hurlwood, located just south of the base, which has a population of 100.

Reese AFB, originally named Lubbock Army Airfield (AAF), opened in June 1941 on 2,000 acres donated by the City of Lubbock. By early 1942, Lubbock AAF began training aviation cadets. The end of World War II brought an end to the use of Lubbock AAF as a training center. From 1945 to 1949 the base was used as a housing facility for veterans and their families. In 1949, the 3500th Pilot Training Wing moved to Lubbock AAF from Barksdale AFB, Louisiana. The base was then renamed for 1st Lieutenant Augustus F. Reese, Jr., a native of nearby Shallowater, Texas.

Presently, Reese AFB is one of several Undergraduate Pilot Training bases (UPT) in the Air Training Command (ATC). Approximately 500 aviation students go through training at a given time, with 400 students graduating annually.

The 64th Flying Training Wing is the major training organization at Reese AFB. The 64th Air Base Group provides administrative and service support. Other organizations on base include:

- 1958 Communications Squadron (AFCS);

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*USAF designation

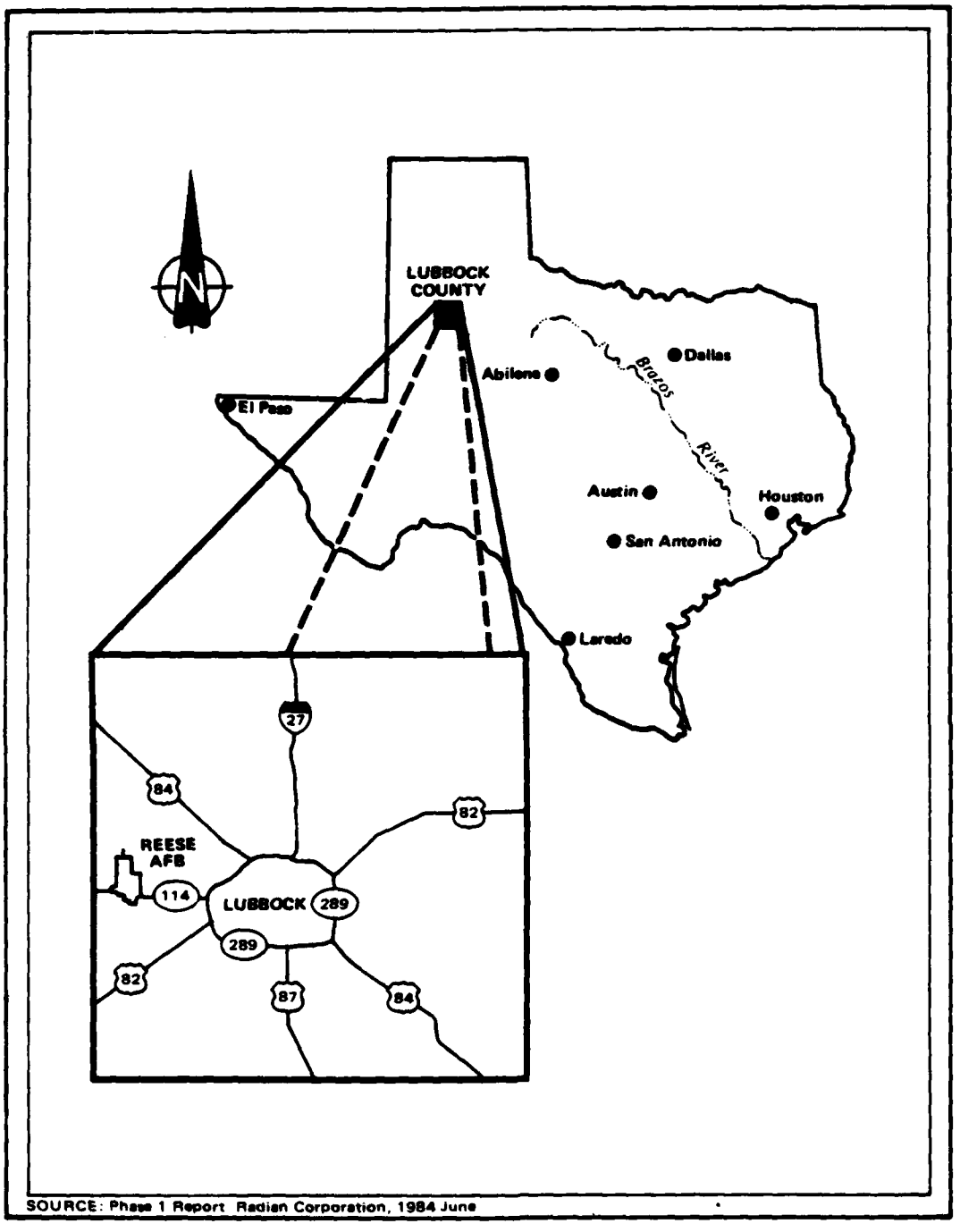


Figure 1–1 REESE AFB LOCATION MAP

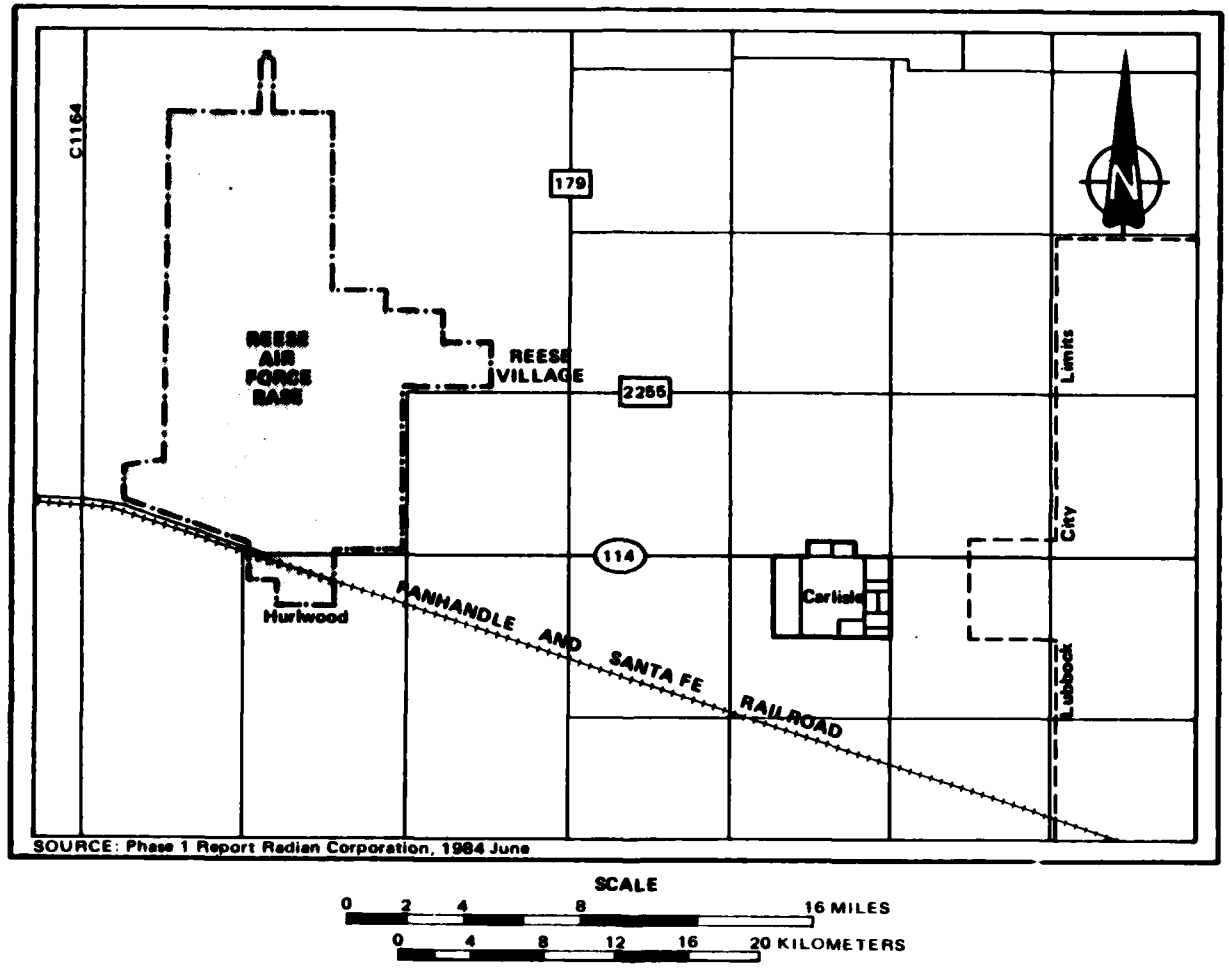


Figure 1–2 REESE AFB AND SURROUNDING AREA

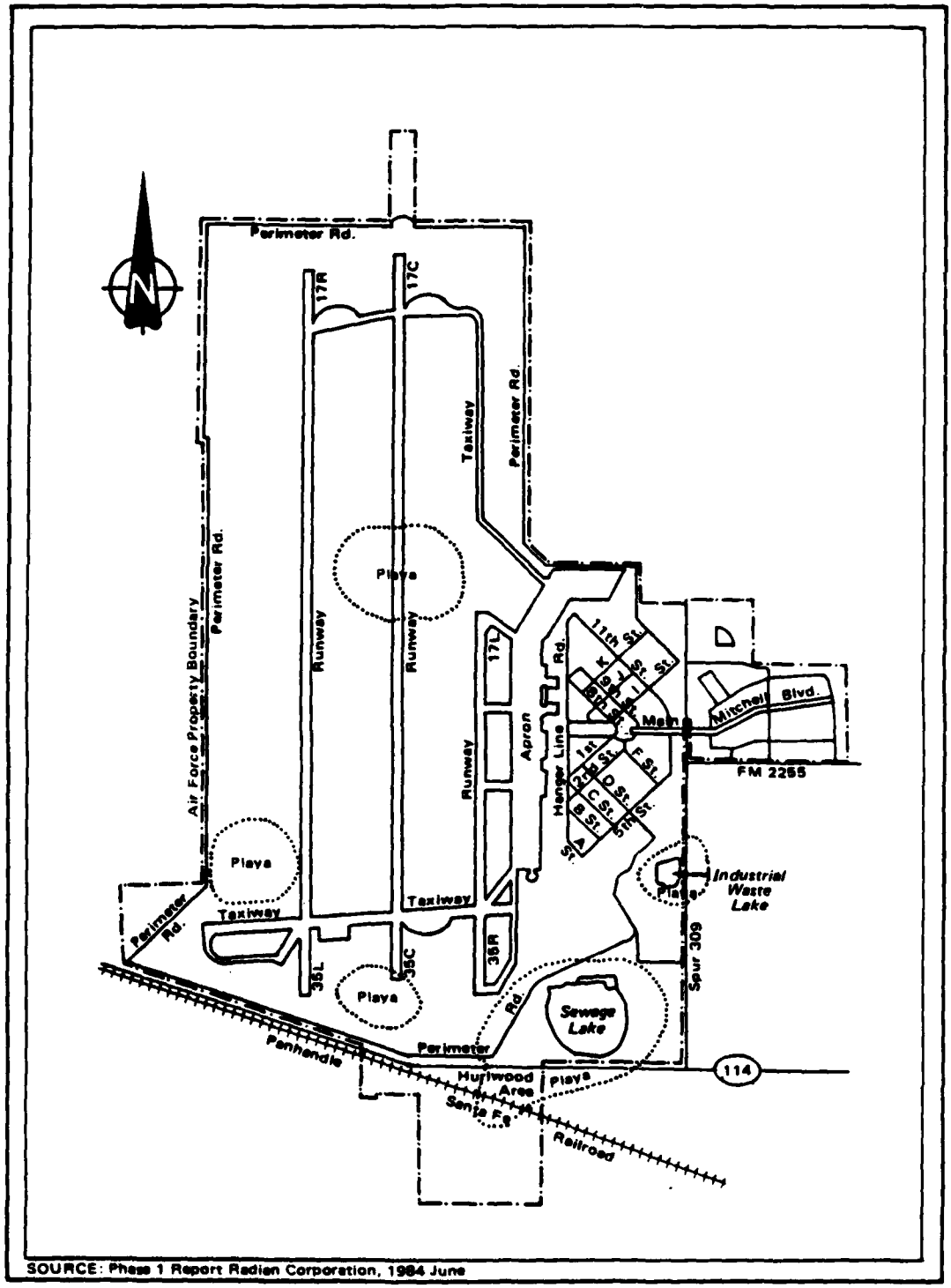


Figure 1–3 REESE AFB SITE LAYOUT

- 24th Weather Station Detachment 11;
- Management Engineering Detachment 11;
- OSI Detachment 1113;
- Field Training Detachment 495 OL; and
- Defense Reutilization and Marketing Office (DRMO).

1.2 AREA DESCRIPTIONS

The primary sources of information for the following site descriptions are the Phase I Report by Radian Corporation (Radian 1984) and the Presurvey Report by E & E (E & E 1985).

1.2.1 Industrial Waste Lake (Area 001)

The Industrial Waste Lake is located in the southeast quadrant of Reese AFB, south of the picnic area and west of Spur 309 (see Figure 1-4). The lake, which covers approximately 4.5 acres, is located in the center of a larger natural playa that extends off base property to the east side of Spur 309. The on-base portion of the natural playa has been receiving storm drainage and industrial wastewater since 1942. Based on aerial photos, it seems the playa was drained and deepened around 1950, which significantly reduced the containment surface area. Despite this deepening, the lake has often overflowed the natural boundaries of the playa, including the area across Spur 309, during periods of heavy rainfall. The area across Spur 309 has been noted to have stressed vegetation.

The Industrial Waste Lake was deepened again in the early 1970s. According to the Phase I report, the dredge material was placed in the Southwest Landfill. However, Civil Engineering personnel who worked at the base during the early 1970s state that the dredge material was used to build up the highway which runs through the playa. In 1977, a pump was installed to pump water from the Industrial Waste Lake to the Sewage Lake. This pumping prevents the Industrial Waste Lake from overflowing. In 1982, a one-way valve was installed that interconnected the halves of the playa under Spur 309. The valve allows water

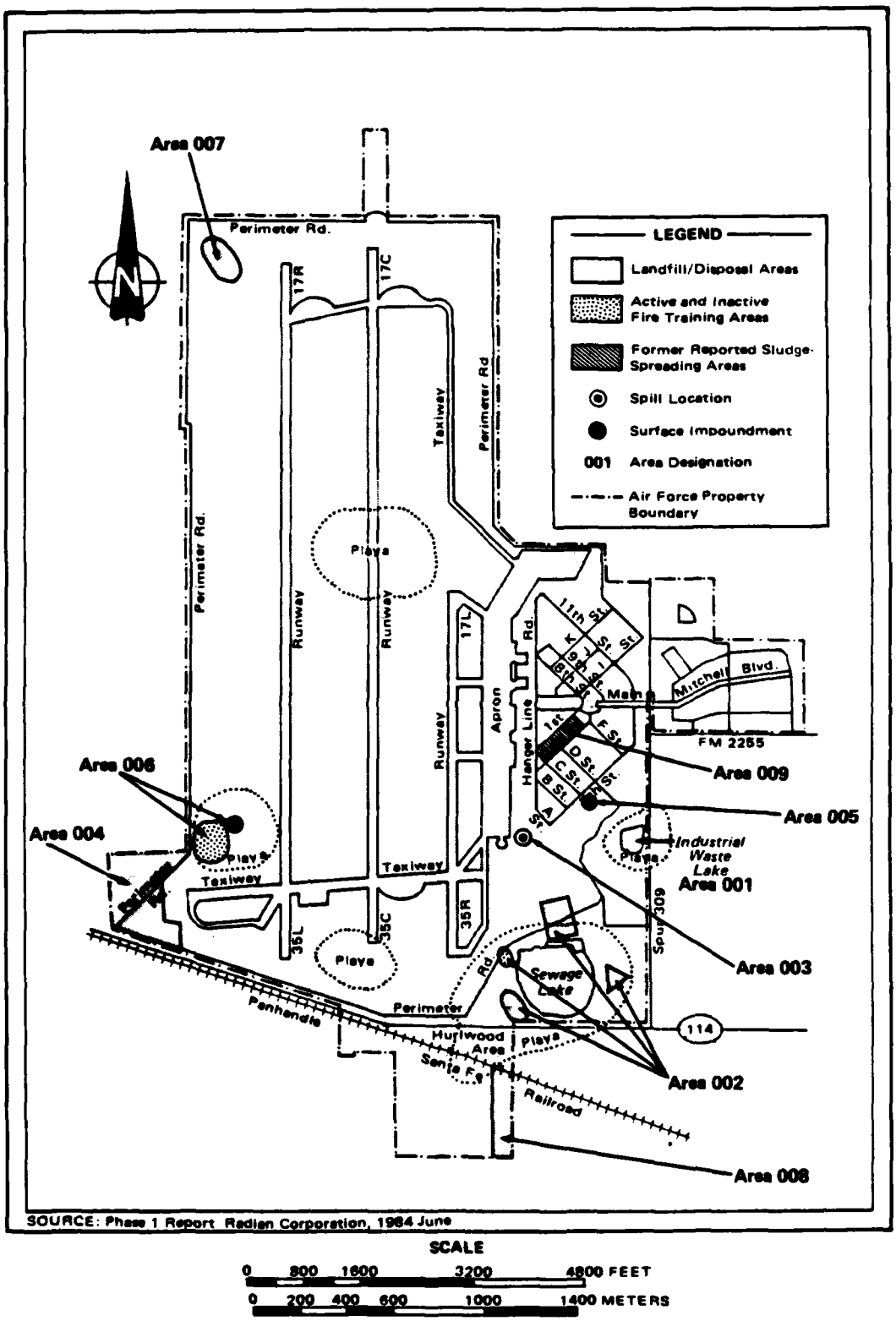


Figure 1–4 IRP PHASE II STAGE I INVESTIGATION AREAS

to flow only from the private property east of Spur 309 into the Industrial Waste Lake.

The Industrial Waste Lake receives surface runoff from most of the base area as well as some drainage from the flight line and industrial shops. At the time of this investigation, the wastewater may have contained paint remover; drag-out (a waste from plating tanks) containing chromium, cadmium, and acids; oil and grease from the parking apron; and detergents. Wastewater from the industrial drain currently passes through an oil-water separator located approximately 0.25 mile upstream from the lake inlet point.

Periodic sample analyses from the Industrial Waste Lake have been conducted by Reese AFB and the Texas Department of Health. The water samples occasionally contain low concentrations of metals and volatile organic compounds. Bottom sediment and sludge samples contain several trace metals. Results from E.P. toxicity extractions indicate that these metals are in a relatively immobile form.

1.2.2 Sewage Lake; East Landfill; North Landfill; and Inactive Fire Training Area (all comprising Area 002)

Sewage Lake

The Sewage Lake, which covers approximately 35 acres with an average water depth of 2 meters, is located in the southeast quadrant of the base near the intersection of Spur 309 and Highway 114 (see Figure 1-4). The lake, which is just south of the Reese AFB sewage treatment plant, is recharged by discharge from the Industrial Waste Lake during flood conditions and treated effluent from the sewage treatment plant. The sewage is treated by a modification of the Hayes process, which includes the following steps: screening, primary sedimentation, first stage contact aeration, intermediate sedimentation, second contact aeration, and final sedimentation. The effluent from the final sedimentation is chlorinated and flows into a lagoon (polishing lake) before entering the playa. The bottom of the lake consists of low-permeability clay. Discharge from the lake is by evaporation and pumping of water for golf course irrigation.

The Sewage Lake has been receiving treatment plant effluent since 1941. On several occasions the water has been drained from the lake.

Sewage digester sludge is spread and dried on the playa banks, along sections of the perimeter road, and on the golf course grounds. Chlorinated water from the Sewage Lake is currently used for golf course irrigation. Sampling data from Appendix H for the Sewage Lake indicates low concentrations of polynuclear aromatic hydrocarbons in the sludge.

Materials currently considered hazardous have been disposed of in the Sewage Lake on several occasions. In 1963 a large volume of asphaltic debris from runway demolition was dumped into the lake. According to the Phase I report (Radian 1984), diesel oil was periodically applied to the pond surface as a mosquitocide until the early 1970s. During the Phase II Stage 1 field effort, dumping of an unknown algeacide or mosquitocide was observed. . Solvents, waste oils, and other industrial wastes from the flight line shops were introduced into the sewage system for a short period between mid-1980 and early 1981. According to the Phase I report, the total volume of wastes introduced from the flight line during this period was estimated as hundreds of gallons. The Sewage Lake also receives water periodically from the Industrial Waste Lake via the overflow pump installed in 1977.

East Landfill

During the 1940s open trenches located east of the Sewage Lake were used for waste disposal (see Figure 1-4). Although the exact locations of the trenches are not known, these trenches generally ran north/south and contained construction/demolition lumber and miscellaneous trash. Most of this material was burned in the ditches, then covered. Since the base was closed during most of the period of landfill operation, base activities most likely contributed little to the waste being disposed of in the trenches. Most of the disposed material consisted of construction debris.

North Landfill

From the 1950s to the mid-1960s, several east-west trending trenches on the north side of Sewage Lake were used for waste disposal (see Figure 1-4). All types of wastes were disposed of in large quantities at the North Landfill, including some hazardous materials.

Waste fuels, oils, construction debris, paint chips, and solvent were all disposed of in the trenches. It has been reported that water was sometimes present in the bottom of the trenches, and occasionally water flow to the playa was observed. Subsidence over the trenches in the past was reported and continues to be a minor problem. Prior to 1946, household and commercial wastes were landfilled over a larger area identified by the Air Force, which included this landfill.

West Landfill

Several trenches trending generally east/west were reported to have existed on the west side of the Sewage Lake (see Figure 1-4). The trenches were reportedly used during the 1950s and early 1960s for disposal of all types of base-generated wastes that could have included industrial compounds and waste oils. The types and quantities of wastes, however, is speculative. Reported areas of subsidence along the perimeter road that may now overlie the former trenches constitute the only physical evidence for the existence of a landfill at this site.

Inactive Fire Training Area

The Inactive Fire Training Area is located on the northwest edge of the Sewage Lake (see Figure 1-4). During the time of its use the primary compound used in fighting fuel fires was carbon tetrachloride.

1.2.3 POL Storage Area (Aquasystem) Spill Site (Area 003)

From approximately 1947 until the early 1960s, the POL storage area used an "aquasystem" (see Figure 1-4). This system was a network of underground aviation gasoline (AVGAS) tanks connected by 12-inch lead pipes which were supported on concrete pedestals. The entire system was buried at a depth of 10 to 12 feet. As part of the fuel delivery system, water was used to float the fuel upward in the tanks and throughout the pipelines.

About 1949, a major leak in the system occurred which was recognized only after a nearby water supply well (No. 4) began pumping AVGAS. It is estimated that approximately 1,000 gallons of mixed AVGAS and water (mix ratio unknown) were lost. Water supply well

No. 4 was subsequently abandoned and sealed. Remedial actions taken as a result of the spill included pumping gas from the well, excavation of contaminated soil, airing of the excavation, repair of the leaking pipes, and backfilling of the excavation with aerated soils.

1.2.4 Southwest Landfill (Area 004)

The Southwest Landfill is the only active landfill within the base property (see Figure 1-4). The site, which covers approximately 25 acres, has had one or more disposal trenches active at any given time since the mid-1950s. At present, only two trenches for disposal of construction-related wastes are in use. However, in the past, domestic and hazardous wastes are known to have been disposed of at this site. Trenches for household and commercial wastes trending parallel to the north side of the site were closed in 1972. At that time, new trenches were opened for construction debris along the southern edge of the area (see Figure 1-5). The entire site was closed to general dumping in 1977. Thereafter, disposal was restricted to nonhazardous solid wastes only.

In the early days of operation, no written records of the types and volumes of wastes and their exact disposal locations were kept. Although permits for dumping were required and weekly inspections were conducted from the mid-1960s onward, most of the information on the wastes in the Southwest Landfill came from interviews with former base employees.

Reportedly, during the late 1950s to early 1960s, a variety of acid wastes and cleaning solutions were disposed of in the Southwest Landfill. Drums were transported to the site, drained, and the empty drums returned to the salvage yard. One estimate places the annual volume of these wastes at about 100 gallons during this period. Other interviewees recalled that approximately thirty 55-gallon drums of unknown origin, four 32-gallon drums of paint chips, and five 20-gallon containers of chromic acid had been stored (and possibly dumped) at the landfill around 1976. All empty containers were returned for salvage.

Other wastes allegedly dumped at this site include scrap aircraft tire debris (late 1950s), large loads of lead pipe from the old aqua-system (1960s), ether (volume unknown) from the base hospital, dredged

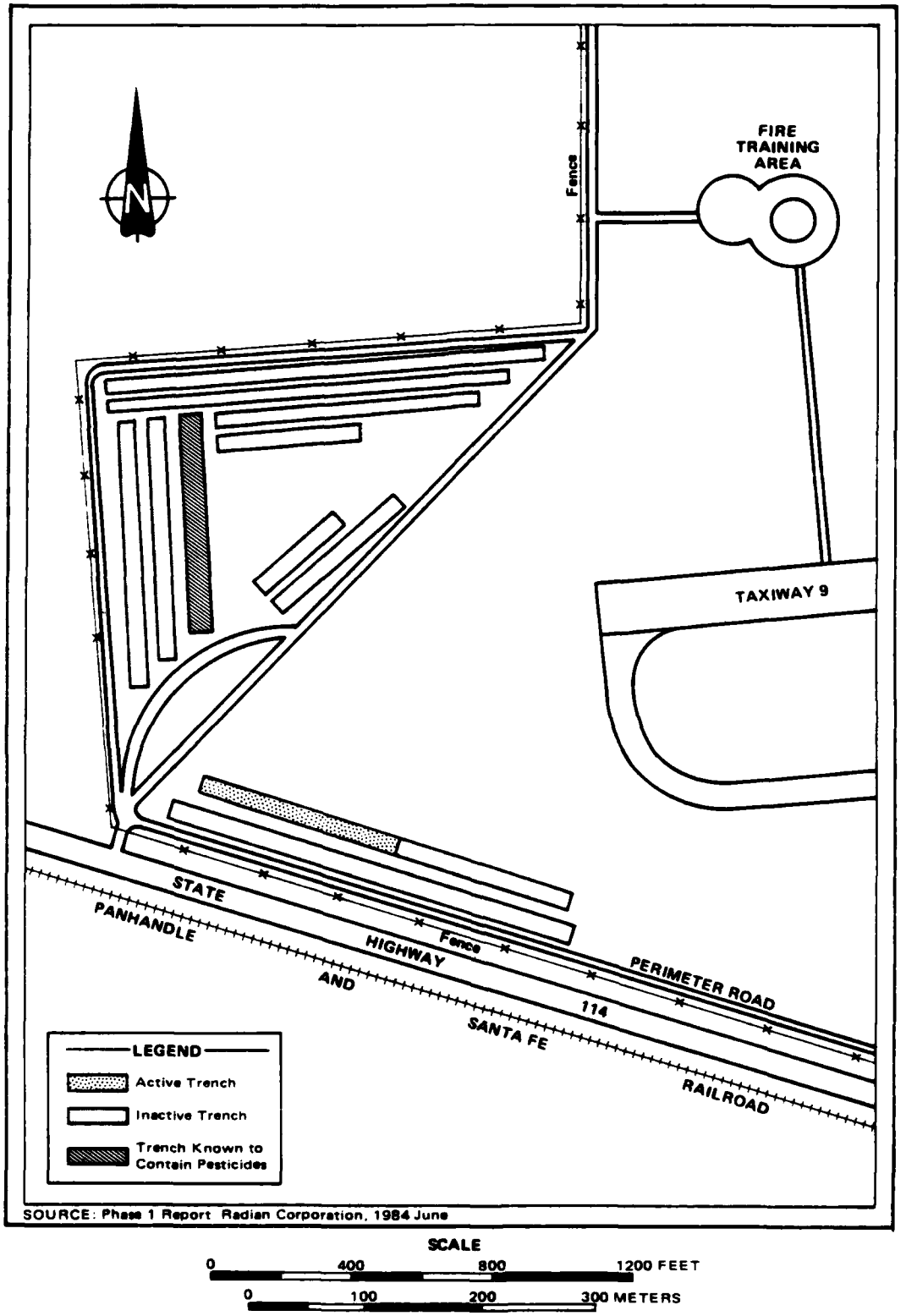


Figure 1–5 DISTRIBUTION OF KNOWN TRENCHES IN THE SOUTHWEST LANDFILL

sludge from the Industrial Waste Lake (early 1970s), and plating tank bottom sludges containing cadmium (1976 or 1977). Pesticides are also known to have been disposed of in two 300 by 30 by 15-foot trenches located near the center of the site.

1.2.5 Civil Engineering Paint Shop Trench (Area 005)

In the 1960s a gravel French drain (8 by 10 by 5 feet deep) was used to dispose of paint shop wastes including kerosene, toluene, acetone, and lacquer thinner. Area 005 was located between the paint shop and the railroad tracks, which have since been removed (see Figure 1-4). When gravel became clogged with paint, the practice was discontinued and the trench was backfilled.

Neither the quantities of wastes disposed nor the exact boundaries of the trench are currently known.

Construction of a new building near the site prompted a study by borings and soil analysis to define the type and extent of contamination. Interviews with Civil Engineering personnel indicated that six borings were drilled in a grid pattern at the approximate location of the trench in February 1985. Soil samples collected indicated low concentrations of paint residue and kerosene. Approximately six months later the trench was excavated to a depth of 25 feet and backfilled with Randall-type clay.

1.2.6 Active Fire Training Area, Including Drainage Impoundment (Area 006)

The Active Fire Training Area (see Figure 1-4), in use since 1965, consists of a work area about 40 feet in diameter with an annular concrete ring surrounding a metal mock-up of a jet plane. Prior to installation of the concrete, soil testing for lead, oil, and grease showed no contamination. At one edge of the site there is a concrete sump to collect drained fluids from the work area. The sump is about 6 feet deep; a gate valve about 1 foot from the bottom allows water to flow out of the sump through a pipe and onto the ground in a natural drainage path to a natural depression augmented by grading.

1.2.7 Northwest Landfill (Area 007)

The Northwest Landfill is located in the northwest quadrant of the base near the perimeter road and northwest of Runway 17R-35L (see Figure 1-4). Waste reportedly disposed here consisted primarily of piles of asphaltic construction debris from runway demolition. According to interview reports, in the early 1970s, 30 to 50 55-gallon drums of unspecified toxic wastes were emptied into trenches along with the construction debris. Approximately two to three years later the debris was spread over a 3- to 5-acre area.

1.2.8 Hurlwood Acquisition and Landfill (Area 008)

This area was formerly part of the Hurlwood community, but was acquired by the Air Force in 1978 to provide a buffer zone between runway noise and residential homes in the area (see Figure 1-4). Five covered, inactive drinking water wells are present on the property, as well as an inactive, leveled landfill which reportedly contained only nonhazardous debris including trash from a cotton gin.

1.2.9 Sewage Digester Sludge Spreading Area (Area 009)

Historically, Reese AFB has used sewage digester sludge as fertilizer on many of the grassy locations on base. Only one area (Site 009) was designated for investigation during Phase II (see Figure 1-4).

As was pointed out in the Phase I report, analyses of the sewage sludge indicates the presence of polynuclear aromatic hydrocarbons (PNAs); however, this report stated that the levels detected do not present a health hazard. However, of potential concern is a report that sometime prior to 1976 chromic acid was mixed with the sewage sludge as a procedure for waste acid disposal.

1.3 TYPES OF CONTAMINANTS INVESTIGATED

The investigation was designed to determine the presence or absence of contamination in surface waters and groundwaters, sediments, and subsurface soils at the defined sites of interest. Table 1-1 shows the analysis performed for each environmental matrix at each site.

Table 1-1

SAMPLE ANALYSES PERFORMED AT REESE AFB

Parameter	Area 001	Area 002	Area 003	Area 004	Area 005	Area 006	Area 007	Area 008	Area 009
Purgeable Organics	Se, S, W	Se, S, W	S	S, W	S, W	Se, S	S	S, W	S
Oil and Grease	Se, S, W	Sw, S, W	S	S, W	S, W	Se, S	S	S, W	S
Phenols	Se[1], S, W	Se[1], S, W	--	W	W	Se, S	--	S, W	--
Base/Neutral/Acid Extractables	Se, S, W	Se, W	--	W	S, W	--	--	W	S
Organochlorine Pesticides/PCB	Se, S, W	Se, W	--	S, W	--	--	--	--	--
Organophosphorous Pesticides	Se, S, W	Se, W	--	S, W	--	--	--	--	--
Chlorinated Herbicides	Se, S, W	Se, W	--	S, W	--	--	--	--	--
Petroleum Hydrocarbons	--	--	S	--	--	--	--	--	--
Polynuclear Aromatic Hydrocarbons	--	--	--	--	--	--	S	--	--
Primary Metals	W	W	--	S, W	W	--	--	W	--
Arsenic	--	--	--	--	--	--	--	S	S
Cadmium	--	--	--	--	S	--	--	--	S
Chromium	--	--	S	--	S	Se, S	--	--	S
Copper	--	--	--	--	--	--	--	--	S
Lead	--	--	S	--	S	Se, S	--	--	S
Nickel	--	--	--	--	S	--	--	--	S
Zinc	--	--	--	--	S	--	--	--	S
Total Dissolved Solids	W	W	--	--	W	--	--	--	--

[1]Phenols were analyzed only on initial four samples from Area 001 and 1 sample from Area 002, which were collected prior to notification that testing for phenols would be discontinued in soil/sediment samples which were being analyzed for BNAs.

Matrix: Se - Sediment
S - Soil
W - Water

Volatile Organics

Halogenated and aromatic hydrocarbons were analyzed by using EPA Methods 601 and 602 for water samples and EPA Methods 8010 and 8020 for soil samples. A listing of the compounds detected by these methods and the corresponding Detection Limits (DL) are presented in Table 1-2.

Pesticides, Herbicides, and PCBs

Soil samples analyzed for organochlorine and organophosphorous pesticides and PCBs were extracted using EPA Method 3550. EPA Method 8080 was used to analyze for organochlorine pesticides and PCBs in soil samples. EPA Method 8140 was used to analyze for organophosphorous pesticides in both soil and water samples. EPA Method 8150 was used to analyze for chlorinated herbicides in soil samples. EPA Method 608 was used to analyze for organochlorine pesticides and PCBs in water samples. Standard Method A509B was used to analyze for chlorinated herbicides in water samples. A listing of the compounds detected by these methods and the corresponding DLs are presented in Table 1-2.

Base/Neutral/Acids (BNAs) - Extractable Organics

Soil samples analyzed for BNAs were extracted using EPA Method 3550 and were analyzed using EPA Method 8270. Water samples were analyzed using EPA Method 625. A listing of the compounds detected by these methods and the corresponding DLs are presented in Tables 1-2.

Oil and Grease

Soil samples analyzed for oil and grease were extracted using EPA Method 3550. Both water and soil samples were analyzed using EPA Method 413.2. The DLs were 100 mg/kg for soil and 200 ug/l for water.

Petroleum Hydrocarbons

Soil samples analyzed for petroleum hydrocarbons were extracted using EPA Method 3550, and analyzed using EPA Method 418.1. The DL for this method was 10 mg/kg.

Table 1-2

ANALYTICAL PARAMETERS AND DETECTION LIMITS
USED FOR REESE AFB INVESTIGATION

Parameter	DL* Soil (mg/kg)	DL* Water (ug/L)
Purgeable Halogenated Hydrocarbons (Methods 601 and 8010)		
Bromodichloromethane	0.25	0.10
Bromoform	1.0	0.20
Bromomethane	0.5	1.18
Carbon tetrachloride	0.25	0.12
Chlorobenzene	0.15	0.2
Chloroethane	0.5	0.52
2-Chloroethylvinyl ether	5.0	0.13
Chloroform	0.25	0.05
Chloromethane	0.5	0.08
Dibromochloromethane	0.25	0.09
1,2-Dichlorobenzene	0.25	0.4
1,3-Dichlorobenzene	0.25	0.4
1,4-Dichlorobenzene	0.25	0.3
Dichlorodifluoromethane	0.5	1.81
1,1-Dichloroethane	0.1	0.07
1,2-Dichloroethane	0.1	0.03
1,1-Dichloroethene	0.1	0.13
trans-1,2,Dichloroethene	0.1	0.10
1,2-Dichloropropane	1.0	0.04
cis-1,3-Dichloropropene	1.0	0.20
trans-1,3-Dichloropropene	1.0	0.34
Methylene chloride	0.05	0.25
1,1,2,2-Tetrachloroethane	0.25	0.03
Tetrachloroethene	0.25	0.03
1,1,1-Trichloroethane	0.25	0.03
1,1,2-Trichloroethane	0.5	0.02
Trichloroethene	0.25	0.12
Trichlorofluoromethane	0.5	2.0
Vinyl chloride	0.5	0.18
Purgeable Aromatics (Methods 602 and 8020)		
Benzene	0.25	0.2
Chlorobenzene	0.25	0.2
1,2-Dichlorobenzene	0.50	0.4
1,3-Dichlorobenzene	0.50	0.4
1,4-Dichlorobenzene	0.50	0.3
Ethylbenzene	0.25	0.2
Toluene	0.25	0.2
Xylenes (Total)	0.50	1.0
Phenolic Compounds (Methods 604 and 8040)		
4-Chloro-3-methylphenol	1.0	0.36
2-Chlorophenol	1.0	0.31
2,4-Dichlorophenol	1.0	0.39
2,4-Dimethylphenol	1.0	0.32
2,4-Dinitrophenol	1.0	13.0
2-Methyl-4,6-dinitrophenol	1.0	16.0
2-Nitrophenol	1.0	0.45
4-Nitrophenol	1.0	2.8
Pentachlorophenol	1.0	7.4
Phenol	1.0	0.14
2,4,6-Trichlorophenol	1.0	0.64

Table 1-2 (Cont.)

Parameter	DL* Soil (mg/kg)	DL* Water (ug/L)
Organophosphorous Pesticides (Method 8140)		
Naled	1.0	0.10
Phorate	1.0	0.15
Disulfoton	1.0	0.20
Chlorpyrifos	1.0	0.30
Dimethoate	1.0	0.30
Malathion	1.0	0.30
Mevinphos	1.0	0.30
Parathion	1.0	0.30
Methylparathion	1.0	0.30
Diazinon	1.0	0.60
Methyl azinphos	1.0	1.5
Polynuclear Aromatic Hydrocarbons (Method 8100)		
Acenaphthene	5.0	--
Acenaphthylene	5.0	--
Anthracene	5.0	--
Benzo(a)anthracene	5.0	--
Benzo(a)pyrene	5.0	--
Benzo(b)fluoranthene	5.0	--
Benzo(ghi)perylene	5.0	--
Benzo(k)fluoranthene	5.0	--
Chrysene	5.0	--
Dibenzo(a,h)anthracene	5.0	--
Fluoranthene	5.0	--
Fluorene	5.0	--
Indeno(1,2,3-cd)pyrene	5.0	--
Naphthalene	5.0	--
Phenanthrene	5.0	--
Pyrene	5.0	--
Pesticides, Herbicides, PCB Compounds (Methods 608, 8080, 8150, and 509)		
Aldrin	1.0	0.05
a-BHC	1.0	0.05
b-BHC	1.0	0.05
g-BHC	1.0	0.05
d-BHC	1.0	0.05
Chlordane	1.0	0.50
4,4'-DDD	1.0	0.10
4,4'-DDE	1.0	0.10
4,4'-DDT	1.0	0.10
Dieldrin	1.0	0.10
Endosulfan I	1.0	0.05
Endosulfan II	1.0	0.10
Endosulfan sulfate	1.0	0.10
Endrin	1.0	0.10
Endrin aldehyde	1.0	0.10
Heptachlor	1.0	0.05
Heptachlor epoxide	1.0	0.05
Toxaphene	1.0	1.0
2,4-D	1.0	0.5
2,4,5-TP (Silvex)	1.0	0.05
2,4,5-T	1.0	0.05

Table 1-2 (Cont.)

Parameter	DL* Soil (mg/kg)	DL* Water (ug/L)
Pesticides, Herbicides, PCB Compounds (Methods 608, 8080, 8150, and 509)		
PCB-1016	1.0	0.50
PCB-1221	1.0	0.50
PCB-1232	1.0	0.50
PCB-1242	1.0	0.50
PCB-1248	1.0	0.50
PCB-1254	1.0	1.0
PCB-1260	1.0	1.0
Primary Metals (Method 200.7, 239.2, 270.2)		
Antimony	15	150
Beryllium	1	10
Cadmium	0.5	5
Chromium	5	50
Copper	2	20
Lead	5	5
Nickel	10	100
Silver	4	40
Thallium	20	200
Zinc	40	50
Base Neutral/Acid Extractable Organics (Methods 625 and 8270)		
1,3-Dichlorobenzene	1	10
1,4-Dichlorobenzene	1	10
Hexachloroethane	1	10
Bis(2-chloroethyl)ether	1	10
1,2-Dichlorobenzene	1	10
Bis(2-chloroisopropyl)ether	1	10
Nitrobenzene	1	10
Hexachlorobutadiene	1	10
1,2,4-Trichlorobenzene	1	10
Isophorone	1	10
Naphthalene	1	10
Bis(2-chloroethoxy)methane	1	10
Hexachlorocyclopentadiene	1	10
2-Chloronaphthalene	1	10
Acenaphthylene	1	10
Acenaphthene	1	10
Dimethyl phthalate	1	10
2,6-Dinitrotoluene	1	10
Fluorene	1	10
4-Chlorophenyl phenyl ether	1	10
2,4-Dinitrotoluene	1	10
Diethylphthalate	1	10
N-Nitrosodiphenylamine	1	10
Hexachlorobenzene	1	10
4-Bromophenyl phenyl ether	1	10
Phenanthrene	1	10

Table 1-2 (Cont.)

Parameter	DL* Soil (mg/kg)	DL* Water (ug/L)
Anthracene	1	10
di-butyl phthalate	1	10
Fluoranthene	1	10
Pyrene	1	10
Benzidine	5	50
Butyl benzyl phthalate	1	10
Bis(2-ethylhexyl)phthalate	1	10
Chrysene	1	10
Benzo(a)anthracene	1	10
3,3'-Dichlorobenzidine	3	30
Di-n-octylphthalate	1	10
Benzo(b)fluoranthene	1	10
Benzo(k)fluoranthene	1	10
Benzo(a)pyrene	1	10
Indeno(1,2-c,d)pyrene	1	10
Dibenzo(a,h)anthracene	1	10
Benzo(ghi)perylene	1	10
phenol	1	10
2-chlorophenol	1	10
2-nitrophenol	1	10
2,4-dimethylphenol	1	10
2-4-dichlorophenol	1	10
4-chloro-3-methylphenol	1	10
2,4,6-trichlorophenol	1	10
2-4-dinitriphenol	3	30
4-nitrophenol	1	10
4,6-dinitro-2-methylphenol	3	30
pentachlorophenol	3	30
Other Parameters		
Petroleum Hydrocarbons (418.1)	10	0.2 mg/L
Oil and Grease (using IR) (418.2)	100	0.2 mg/L
EP Toxicity (SW 846-1310)	a**	--
Arsenic (Method 206.2, 7060)	5.2	5
Cadmium (Method 200.7, 6010)	0.5	5
Chromium (Method 200.7, 6010)	<5	10
Copper (Method 200.7, 6010)	2.5	20
Lead (Method 239.2, 7421)	5	5
Nickel (Method 200.7, 6010)	10	0.1
Zinc (Method 200.7, 6010)	4	50

*Detection limits (DLs) are provided for soil in mg/kg and for water in ug/L, except where noted otherwise.

**Key:

a Metal	ug/L of leaching solution
As	500
Ba	5000
Cd	100
Cr	500
Pb	500
Hg	0.8
Se	500
Ag	500

Polynuclear Aromatic Hydrocarbons (PNAs)

Soil samples analyzed for PNAs were extracted using EPA Method 3550 and were analyzed using EPA Method 8100. Compounds detected and the corresponding DLs are presented in Table 1-2.

Phenols

Soil samples analyzed for phenols were extracted using EPA Method 3550 and analyzed using EPA Method 8040. Water samples were analyzed using EPA Method 604 (see Table 1-2). A listing of the compounds detected by these methods and the corresponding DLs are presented in Table 1-2.

Total Dissolved Solids

Total dissolved solids in water samples were determined using EPA Method 160.1. The detection limit was 1 mg/L.

Primary Metals

Soil samples analyzed for primary metals were extracted using EPA Method 3050 and analyzed using EPA Method 6010. Water samples were analyzed using EPA Method 200.7. Metals detected by these methods and DLs are listed in Table 1-2.

Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Zinc

Soil samples for these metals were extracted using EPA Method 3050. Analysis was done using the EPA Methods and DLs listed in Table 1-2.

pH

The pH of the water samples was determined using EPA method 150.1.

EP Toxicity (Metals)

EP toxicity on soil samples was determined using the methods in SW846. DLs are listed in Table 1-2.

Ignitability

Ignitability on soil samples was determined using EPA Method 1010. If a sample is ignitable at 140° Fahrenheit or below, it is a hazardous waste in accordance with 40 CFR 261.21.

1.4 FIELD PERSONNEL

E & E field personnel participating in this project and their responsibilities were:

- Michael E. Benner - Project Manager, Chief Geologist;
- Paul Brodzik - Assistant Project Manager, Chemical Engineer;
- William Park - Health and Safety Officer;
- Donald Smith - Chemist; and,
- David Palmerton - Geologist.

1.5 SUBCONTRACTORS

Environmental Drilling Corporation of Tulsa, Oklanoma, provided drilling, drum handling, and well pumping services. Field personnel from Environmental Drilling Corporation were:

- Roy Burson - Field Supervisor;
- Bob Masten - Driller;
- Bob Knopf - Driller;
- Henry Price - Helper;
- Eddie Chandler - Helper;
- Rick Reed - Helper;
- Nathan Williams - Helper; and,
- Bobby Holland - Helper.

Surveying services were provided by Parkhill, Smith, and Cooper of Lubbock, Texas. The surveying field crew consisted of:

- Larry Drewes - Party Chief;
- Gerald McMahan - Instrument Man;
- James Curry - Rodman; and
- Jerry McMahan - Rodman.

2. ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHY

Reese AFB is located in the High Plains region of Texas, a flat plateau which is the southernmost extension of the Great Plains Physiographic Province. A significant characteristic of the area is the large number of playas (shallow depressions) scattered across the land surface. These playas accumulate surface runoff during periods of precipitation. Only a small amount of rainfall drains to streams (Knowles, Nordstrom, and Klemt 1984).

2.2 TOPOGRAPHY

Topography of the area is characterized by playas and channelization by intermittent streams. Topography is generally flat. Land surface slopes are typically about 2 percent to the southeast. Slopes may increase to about 8 percent adjacent to playas, lakes, and intermittent streams.

Mean elevation at Reese AFB is 3,338 feet above mean sea level. Relief across the base in only about 25 feet. Surface slopes on the base are generally 1 to 3 percent (Radian 1984).

2.3 CLIMATE

The average temperature at Reese AFB is 60°F, with a range of extremes from -9° to 108°F. Annual precipitation averages 16.9 inches, with about 80 percent of this total occurring between May and October. Table 2-1 shows average temperature, rainfall, and snowfall data.

Table 2-1

TEMPERATURE AND PRECIPITATION DATA

	Temperature (°F)					Precipitation (in)				Snowfall (in)		
	Mean			Extreme		Monthly				Monthly		
	Daily											
Month	Max	Min	Monthly	Max	Min	Mean	Max	Min	Max 24 hrs	Mean	Max	Max 24 hrs
January	53	26	40	81	-9	0.5	2.3	<1.0	1.2	4	27	17
February	57	30	43	86	-6	0.7	2.2	<1.0	1.8	4	21	18
March	64	37	51	94	10	0.6	2.5	<1.0	1.5	1	17	12
April	74	47	61	96	23	2.2	3.0	0.0	1.6	<1	<1	<1
May	82	57	69	102	28	2.7	8.8	0.1	2.4	0	0	0
June	90	65	78	108	46	2.1	5.0	0.2	2.2	0	0	0
July	91	68	80	106	54	2.5	7.9	0.1	2.9	0	0	0
August	89	66	78	102	54	2.0	6.6	<1.0	2.3	0	0	0
September	82	59	71	100	39	1.7	7.0	<1.0	2.38	0	0	0
October	74	49	61	93	26	2.1	6.1	0.0	3.0	1	9	6
November	62	37	50	88	1	0.5	1.6	<1.0	1.2	2	11	8
December	55	29	42	80	3	0.3	1.7	<1.0	0.8	2	11	6
Annual	73	48	60	108	-9	16.9	8.8	<1.0	3.0	16	27	18

Source: USAF, Environmental Technical Applications Center, August 1979.

Evaporation is greatest during the summer months with the average evaporation potential for an open-water surface being about 3.5 times the average annual precipitation (Knowles, Nordstrom, and Klemt 1984).

Prevailing winds in the Lubbock area are from the south from March to October and from the west throughout the remainder of the year. Mean wind speed is 17 mph. Winds blow regularly in the area and result in numerous dust storms. Hailstorms are likely during the summer months, as are tornados (3 to 5 can be expected in a typical year).

2.4 SOILS

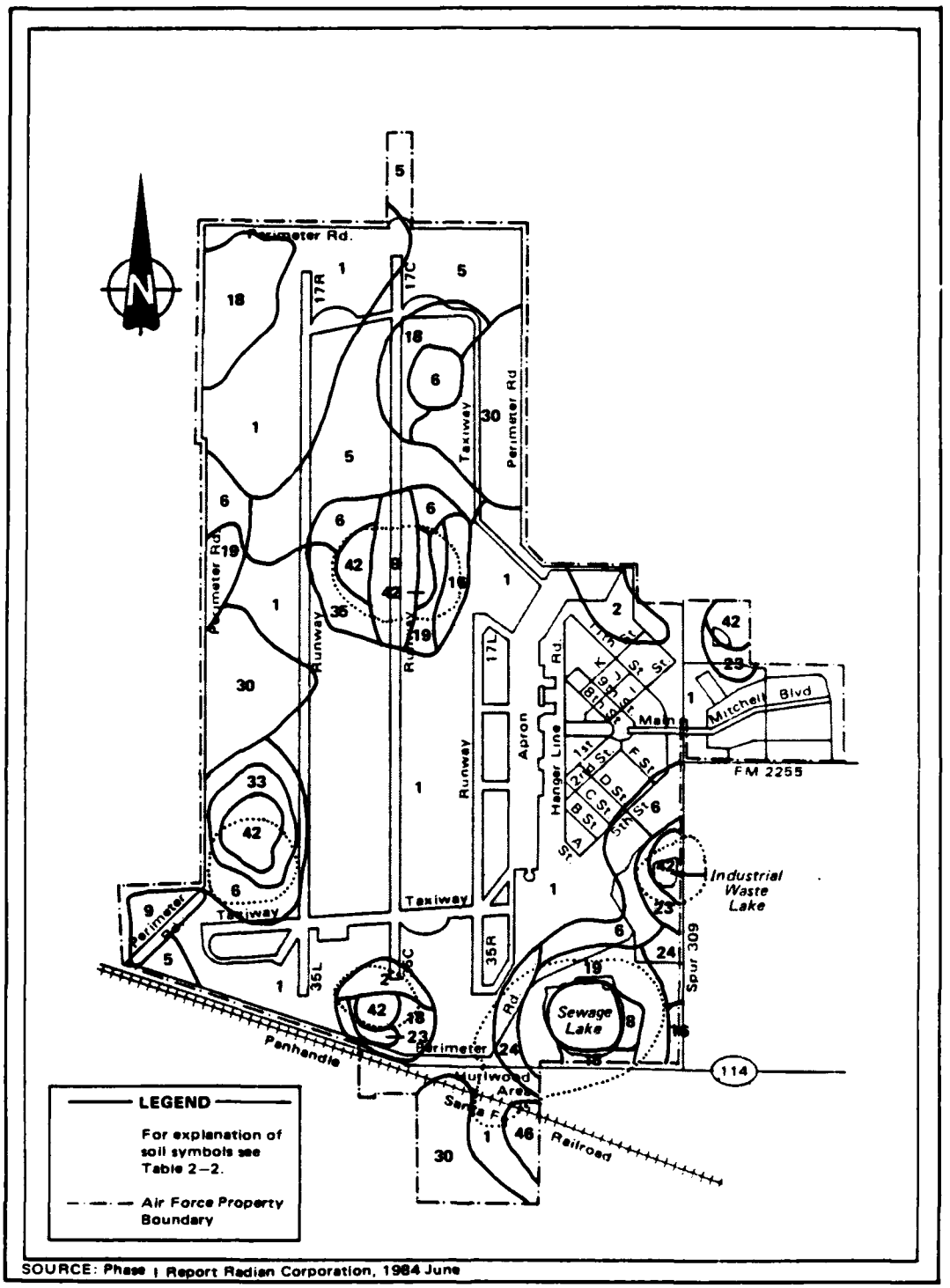
The United States Soil Conservation Service has identified 11 soil series on Reese AFB. These soils are primarily clay, sandy loam, and clay loam. Figure 2-1 shows the location of these soils series, and the series are described on Table 2-2.

The prevalent soil series is the Acuff, a sandy clay loam. Acuff is well-drained with a moderate permeability of 4.2×10^{-4} to 1.4×10^{-3} cm/sec. Randall clay, a poorly drained very low permeability soil (4.2×10^{-5}) cm/sec underlies the Industrial Waste Lake playa and the central runway area. Amarillo soils, the most permeable soils on the base (1.4×10^{-3} to 4.2×10^{-3} cm/sec), are found in the area of the Northwest Landfill (Area 007) and approximately 200 feet from the Industrial Waste Lake.

2.5 SURFACE DRAINAGE

Surface runoff during periods of heavy precipitation collects in the shallow playas or depressions across the base. The playas are typically circular with interior drainage toward the center. Most of these playas are from 150 to 300 feet in diameter and less than 3 feet in depth.

No natural permanent surface water bodies are found on the base. Storm water runoff is directed to culverts or is permitted to follow natural surface slope. Three of the areas of storm water collection on the base are playas, and two are part of the base waste disposal system and are wet year round. Figure 2-2 shows the base drainage features.



SOURCE: Phase I Report Radian Corporation, 1984 June

SCALE

0 800 1600 3200 4800 FEET

0 200 400 600 1000 1400 METERS

Figure 2–1 SOILS MAP OF REESE AFB

Table 2-2

SOIL CHARACTERISTICS ON REESE AFB

Map Symbol	Soil Name and % Slopes	Depth (in)	Permeability (in/hrs)	Description	Drainage
1 2	Acuff loam: 0 - 1% slopes 1 - 3% slopes	80	0.6 - 2.0	Friable fine sandy clay loam. $CaCO_3$: 20 - 60%.	Well drained; slow to medium runoff.
5 6	Amarillo fine sandy loam: 0 - 1% slopes 1 - 3% slopes	80	2.0 - 6.0 upper 14" 0.6 - 2.0 from 14" - 80"	Friable fine clay loam or sandy clay loam. $CaCO_3$: 30% at about 46".	Well drained; slow to medium runoff.
8	Arch loam: 0 - 3% slopes	62	0.6 - 2.0	Friable fine loamy, mixed; moderately alkaline.	Well drained; slow runoff.
9	Arents and Pits: up to 8%	--	--	Made or reworked land.	Well drained; slow to rapid runoff.
16	Drake clay loam: 1 - 3% slopes	60	0.6 - 2.0	Friable fine loamy; moderately alkaline; soft masses of $CaCO_3$ at depth.	Well drained; rapid runoff.
18 19	Estacado clay loam: 0 - 1% slopes 1 - 3% slopes	66	0.6 - 2.0	Friable, moder ately alkaline; 10 - 50% $CaCO_3$ at depth.	Well drained; slow runoff.
23	Lofton clay loam: 0 - 1% slopes	72	<.06 - 0.6	Friable, mildy alkaline mixed clay loam. 15 - 35% $CaCO_3$ below 50".	Moderately well drained; very slow runoff.
24	Mansker clay loam: 1 - 3% slopes	60	0.6 - 2.0	Friable, moderately alkaline loam; 35% $CaCO_3$ at about 8 - 15"; 60% $CaCO_3$ from 15 - 32"; 10% $CaCO_3$ below 32".	Well drained, medium runoff.
30	Olton clay loam: 0 - 1% slopes	80	0.2 - 2.0	Friable, mildly alkaline clay loam; 40% $CaCO_3$ from 38 - 58"; 10% $CaCO_3$ below 58".	Well drained; slow runoff.
33	Portales loam: 0 - 1% slopes	80	0.6 - 2.0	Friable, moderately alkaline loam; 40% $CaCO_3$ from 36 - 60"; 10% $CaCO_3$ below 60".	Well drained, very slow runoff.

Table 2-2 (Cont.)

Map Symbol	Soil Name and % Slopes	Depth (in)	Permeability (in/hrs)	Description	Drainage
35	Posey fine sandy loam: 1 - 3% slopes	80	0.6 - 2.0	Friable, moderately alkaline sandy loam; 10% $CaCO_3$ from 6 - 26"; 35% $CaCO_3$ from 26 - 42"; firm 10% $CaCO_3$ below 42".	Well drained; medium runoff.
42	Randall clay:	62	<0.6	Very firm moderately alkaline clay.	Poorly drained; ponded runoff.

Source: Blackstock 1979.

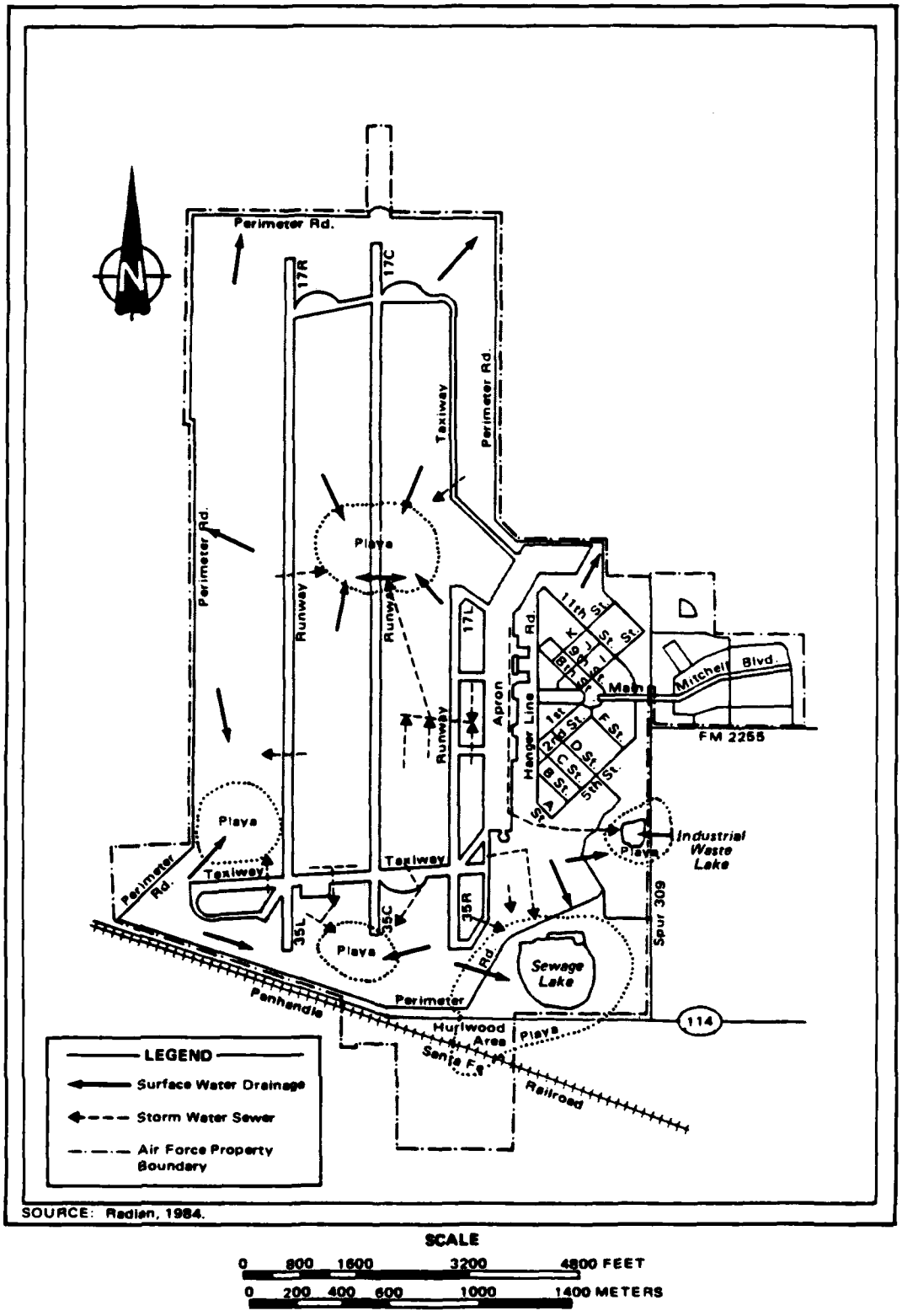


Figure 2–2 NATURAL AND MAN-MADE DRAINAGE PATHWAYS

2.6 GEOLOGY AND HYDROGEOLOGY

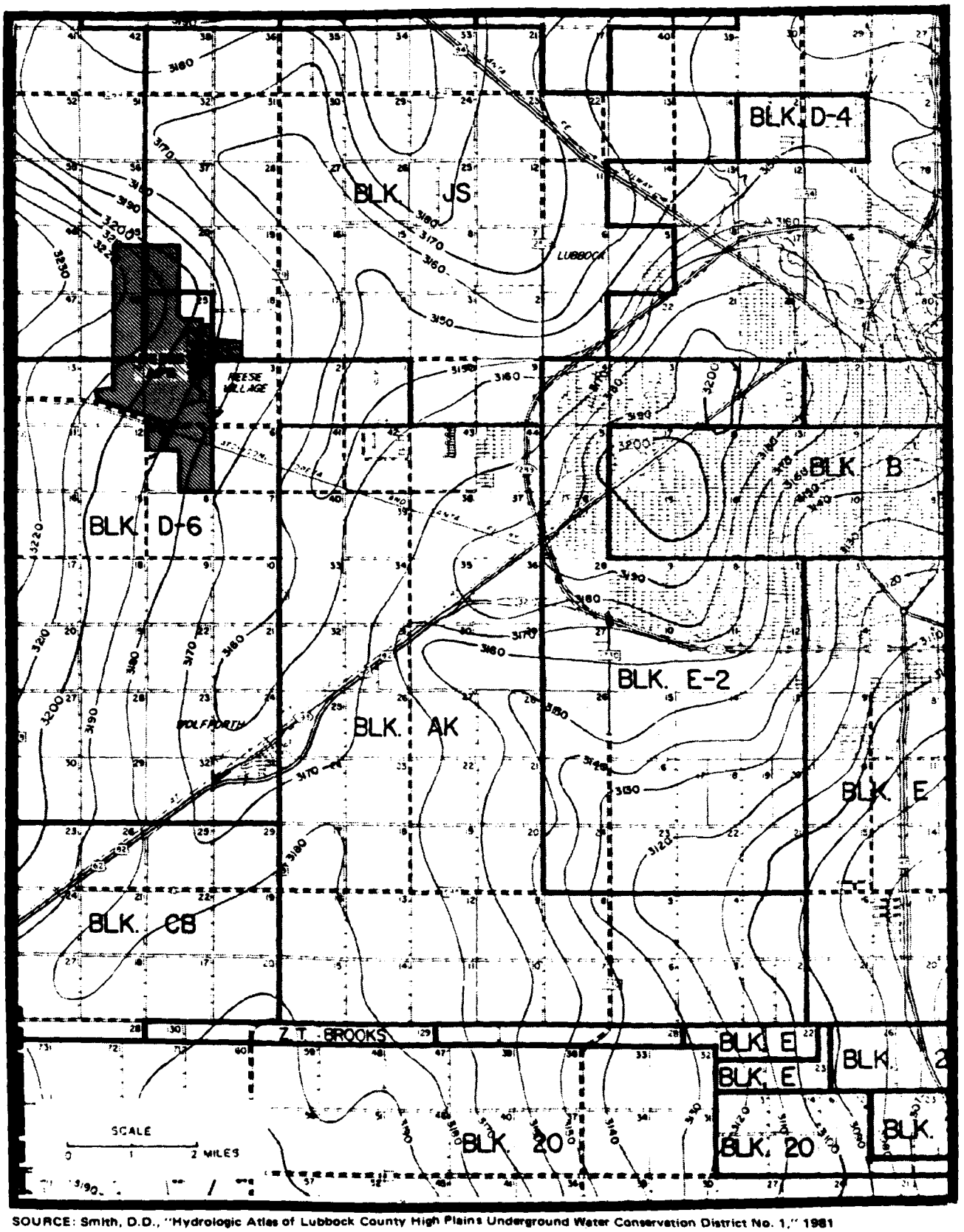
Geologic units outcropping in the Southern High Plains of Texas range in age from Pliocene to Recent. Surface deposits throughout most of the High Plains are a variable thickness (generally less than 9 feet) of windblown fine-grained to silty calcareous sediments. Lacustrine deposits, consisting primarily of low permeability silts and clays, occur in the bottoms of the playas. These sediments are virtually impermeable and restrict recharge to the lower formations (Knowles, Nordstrom, and Klemt 1984).

The Pliocene-age Ogallala Formation is the dominant surface unit in the vicinity of Reese AFB. The Ogallala Formation in Texas is the southernmost extension of the major water-bearing unit underlying the Great Plains physiographic province. The Ogallala consists primarily of discontinuous interbedded silts, sands, clays, and limestones. Logs of wells drilled on the base and throughout the area indicate a caliche zone, varying in thickness from 20 to about 40 feet, is present near the surface. Reeves (1970) has classified the caliche as ranging from crumbly to very hard and being almost impermeable, although secondary porosity has been observed. The effect of the caliche layer is that downward migration is greatly retarded except in areas of secondary porosity.

The Ogallala Formation is the principal aquifer in the High Plains of Texas, and provides nearly all the water used. Recharge to the Ogallala occurs principally by infiltration of precipitation on the outcrop. Only a small percentage of the precipitation actually reaches the water table as a result of the small annual precipitation, high evaporation rate, and low infiltration rate (Knowles, Nordstrom, and Klemt 1984). On the average less than 0.2 inch of water per year reaches the water table as natural recharge (Klemt 1981).

Water within the Ogallala generally occurs under water table conditions; however, slight artesian conditions may exist on a local basis. The depth to the top of the water table is about 120 feet. Figure 2-3 shows the water table surface of the Ogallala Formation. Groundwater flow is generally easterly except where local pumping affects the flow gradient.

Water levels within the High Plains aquifer are generally declining due to the groundwater mining effect of overpumpage and lack of



SOURCE: Smith, D.D., "Hydrologic Atlas of Lubbock County High Plains Underground Water Conservation District No. 1," 1981

Figure 2–3 APPROXIMATE ALTITUDE OF THE WATER TABLE IN THE OGALLALA AQUIFER, 1980, LUBBOCK COUNTY, TEXAS

recharge. A 6.19 feet decline in water level was documented from water level measurements in observation wells between 1970 and 1980 (Smith 1981). Between January 1980 and January 1981, an average decline of 1.81 feet was observed (Smith 1981).

The Ogallala overlies Permian, Triassic, Jurassic, and Cretaceous strata. Table 2-3 shows the geologic units and their water-bearing characteristics.

2.7 GROUNDWATER QUALITY

The sediments comprising the Ogallala play a major role in determining the water quality. Water obtained from the Ogallala in the region of Reese AFB is generally suitable for drinking, irrigation, and most industrial use. Elevated levels of fluoride and, in some instances, selenium are not uncommon in water derived from the Ogallala (Gray 1986). Table 2-4 lists typical water quality of several community wells within a one-mile radius of Reese as analyzed for a number of parameters, (reported by the Texas Department of Health). The locations of community wells No. 3, No. 5, No. 6, and No. 8 from Table 2-4 are shown on Figure 2-4 (see back pocket). The other community wells from Table 2-4 are outside of the 1-mile study radius and located beyond the map scale of Figure 2-4.

2.8 LOCAL WATER USE

More than 98 percent of the base's potable water supply needs are provided through the City of Lubbock. The remaining supply and non-potable uses are derived from four active wells at the base. Eight other wells are either inactive or abandoned. All of these wells tap the Ogallala aquifer. Figure 2-4 shows the location of the wells. Table 2-5 shows operational status and history of the wells on Reese AFB.

A large number of irrigation and community wells occur within one mile of Reese AFB. Data on most large capacity wells are available through the High Plains Underground Water Conservation District No. 1. Permits for wells drilled since the mid-1960s are on file at the Lubbock office. The High Plains District has field-checked the location and presence of wells in this area of Lubbock County. Figure 2-4

Table 2–3

Geologic Units and Their Water-Bearing Characteristics

System	Series	Group	Formation	Approximate maximum thickness (ft)	Physical character of rocks	Water-bearing characteristics	
Quaternary	Pleistocene to Recent		Alluvium, eolian and lacustrine deposits	150	Windblown sand and silt, fluvial flood plain deposits and silt and clay playa lake deposits	Yields small amounts of water to wells	
Tertiary	Late Miocene to Pliocene		Ogallala	900	Tan, yellow, and reddish-brown silty to coarse-grained sand mixed or alternating with yellow to red silty clay and variable sized gravel Caliche layers common near surface	Yields moderate to large amounts of water to wells The principal aquifer in the study area with yields of some wells in excess of 1 000 gal /min	
Cretaceous	Gulf	Colorado	Graneros Shale	45	Dark-gray shale	Not known to yield water to wells	
		Dakota	Dakota Sandstone	190	Tan to yellowish-brown, fine to medium-grained, thin to massive bedded sandstone with interbedded gray shale	Yields as much as 150 gal /min to irrigation wells in the northwest part of Dallam County	
	Comanche	Washita	Purgatoire	100	Upper member a dark-gray shale Lower member a massive, buff to white, fine to coarse-grained, poorly cemented sandstone	Yields as much as 500 gal /min to irrigation wells in the northwest part of Dallam County	
			Duck Creek	35	Yellow, sandy shale and thin gray to yellowish-brown, argillaceous limestone beds	Not known to yield water to wells	
		Fredericksburg	Kiamichi	100	Thinly laminated, sometimes sandy gray to yellowish brown shale with interbeds of thin, gray, argillaceous limestone and thin yellow sandstone	Yields small amounts of water locally to wells	
			Edwards Limestone	40	Light-gray to yellowish-gray thick bedded to massive fine to coarse-grained limestone	Locally yields moderate to large amounts of water to wells from fractures and crevices	Yields small amounts of water to wells
			Comanche Peak Limestone	55	Light-gray to yellowish-brown, irregularly bedded, argillaceous limestone and thin interbeds of light-gray shale		Yields small amounts of water to wells
			Walnut	25	Light-gray to yellowish-brown fine to medium grained, argillaceous sandstone, thin bedded, gray to grayish-yellow, calcareous shale and light-gray to grayish-yellow, argillaceous limestone	Not known to yield water to wells	
		Trinity	Antlers	125	White, gray, yellowish-brown to purple fine to coarse-grained argillaceous, loosely cemented sand, sandstone and conglomerate with interbeds of siltstone and clay	Yields small to moderate amounts of water to wells in the southern quarter of the study area	
Jurassic	Upper		Morrison	550	Grayish green to red shale white to brown fine to coarse grained sandstone some clay conglomerate and limestone brown silt member at base	Yields small amounts of water to livestock wells in north central Dallam County	
			Exeter Sandstone	50	White to brown massive, fine to medium grained sandstone	Yields as much as 20 gal /min to wells	
Triassic	Upper	Dockum	Undivided	2,000	Upper unit Trujillo Formation variocolored siltstone claystone conglomerate fine grained sandstone and limestone Lower unit Tecovas Formation variocolored fine to medium grained sandstone with some claystone and interbedded shale Includes units equivalent to Chinle Formation and Santa Rosa Sandstone	Yields small to moderate amounts of water to wells Water quality variable with stratigraphic position and depth	
Permian	Upper		Undivided	1,000+	Very fine to fine grained red sandstone and shale white to brown gypsum anhydrite and dolomite	Yields small amounts of water to wells near the outcrop Water quality generally slightly saline	

SOURCE: Knowles, Nordstrom, and Klemt; 1984.

Table 2-4

TYPICAL GROUNDWATER QUALITY

Parameter (mg/L unless noted)	Well No.	1	2	3	4	5	6	7	8	9
	Date:	6/20/84	12/12/83	11/19/85	12/12/83	3/24/83	4/29/85	12/13/83	3/9/84	12/15/77
Calcium		54	85	26	67	35	51	45	39	69
Magnesium		52	88	42	75	64	67	64	67	12
Sodium		82	122	126	135	162	107	137	157	36
Carbonate		0	0	10	0	0	0	0	0	--
Bicarbonate		346	375	398	392	540	470	558	527	300
Sulfate		122	218	93	219	118	114	84	114	35
Chloride		84	218	51	139	89	102	83	104	15
Fluoride		4.6	3.9	5.3	4.3	5.7	4.5	4.7	8.6	1.3
Nitrate		3.78	4.45	.67	5.60	.76	.69	2.94	2.11	.59
Dissolved Solids		599	955	564	871	758	696	718	779	319
Phenolphthalein Alkalinity as $CaCo_3$		0	0	9	0	0	0	0	0	--
Total Alkalinity, as $CaCo_3$		284	307	344	321	443	385	457	432	--
Total Hardness as $CaCo_3$		349	574	239	476	352	404	374	371	--
pH		8.2	7.6	8.4	7.6	7.9	8.0	8.1	8.1	--
Diluted Conductance Micromhos/cm		1200	1925	1078	1727	1529	1397	1430	1551	--
Potassium		13	16	11	14	15	--	--	20	--
Arsenic		.011	<.01	.02	.01	.016	<.01	0.19	<.01	<.01
Barium		<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Cadmium		<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
Chromium		<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02

Table 2-4 (Cont.)

Parameter (mg/L unless noted)	Well No.	1	2	3	4	5	6	7	8	9
	Date:	6/20/86	12/12/83	11/19/85	12/12/83	3/24/83	4/29/86	12/13/83	3/9/84	12/15/77
Copper		<.02	<.02	<.02	.07	<.02	.03	<.02	<.02	<.02
Iron		.11	.02	.02	.03	<.02	<.02	<.02	<.05	--
Lead		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	--
Manganese		<0.2	<0.2	.13	<0.2	.27	<0.2	<0.2	<0.2	<0.2
Mercury		<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Selenium		<.002	.012	.011	.029	.005	<.002	.019	.032	.003
Silver		<.01	<.01	<.01	.01	.01	<.01	<.01	<.01	<.01
Zinc		.16	.03	.28	.11	.04	.08	.18	.03	--

Well No./Location

1. Community Water Co./Plott Acres
   5433 9th Street
   Lubbock, Texas 79416
   Samples Wells Nos. 1 and 3; Depths 165' and 148'
   Date: 6/29/84

2. Town and Country Mobile Estates
   Route 8, Box 33
   Lubbock, Texas 79416
   Sampled Well No.1 ; Depth 176'
   Date: 12/12/83

3. Freedom Mobile Home Park
   Route 11, Box 152A-29
   Lubbock, Texas 79407
   Sampled Wells Nos. 1 and 2; Depth unknown
   Date: 11/19/85

4. Hideaway Apartments
   Route 8, Box 34-F-16
   Lubbock, Texas 79407
   Sampled Well No. 1; Depth 186'
   Date: 12/12/83

5. Santa Maria Apts. & Trailer Park
   5018 16th Street
   Lubbock, Texas 79416
   Sampled Well No. 1; Depth 170'
   Date: 3/24/83

6. Elm Grove Mobile Home Park
   Route 11, Box 171 D
   Lubbock, Texas 79407
   Sampled Well No. 1; Depth 270'
   Date: 4/29/85

7. Pecan Grove Mobile Home Park
   Route 11, Box 168
   Lubbock, Texas 79407
   Sampled Well No. 1; Depth unknown
   Date: 12/13/83

8. Roadrunner Village Mobile Home Park
   Route 11, Box 170-10
   Lubbock, Texas
   Sampled Wells Nos. 1 and 2; Depth 165'
   Date: 3/9/84

9. Five well mixture taken from wells on Reese AFB. Date: 12/15/77

Source: Texas Department of Health, 1986.

Table 2-5

REESE AFB WELL DATA AND STATUS

Well No.	Date Drilled	Total Depth (ft)	Original Water Level (ft)	Specific Capacity (GPM/ft)	Current Status	Date of Closure*	Comments
1	1941	157	130.4	11.06	Active	--	--
2	1941	N/A	N/A	N/A	Closed	Before 1976	--
3	1941	N/A	N/A	N/A	Closed	Before 1976	--
4	1942	N/A	N/A	N/A	Closed	Before 1976	--
5	1942	159	132.7	4.93	Active	--	--
6	1944	N/A	N/A	N/A	Closed	After 1976	--
7	1944	N/A	N/A	N/A	Closed	Before 1976	--
8	1945	165	135	5	Active	--	--
9	1959	162	121	2.17	Active	--	Used for irrigation of athletic fields
10	1965	N/A	N/A	N/A	Closed	Before 1976	--
11	1967	N/A	N/A	N/A	Closed	Before 1976	--
12	1968	161	120	0.4	Inactive	Deactivated 1985	Non-potable water

*Closure dates not recorded. Closure identified as before or after 1976 water analysis report.

N/A: Data not available.

Source: Reese Real Property Records.

shows the location of active and abandoned wells within one mile of Reese AFB (see back pocket).

Homes and businesses within one mile of the base rely on private water-supply wells. Wells which supply small communities, and those with 15 or more service connections, are on file at the Texas Department of Health. These small communities are clusters of homes, primarily mobile home parks. Based upon discussions with the Texas Department of Health, the High Plains Conservation District, and base personnel, it was determined that no public supply is available to residents or businesses (McReynolds 1986; Gray 1986; Keller 1986).

All wells within the area tap the Ogallala aquifer and are in the range of 150 to 200 feet in depth.

3. FIELD PROGRAM

3.1 PROGRAM DEVELOPMENT

A field program for the Phase II Confirmation/Quantification (Stage I) investigation was developed by E & E and presented in the Presurvey Report submitted on May 10, 1985. The program was reviewed and modified by the Air Force and set forth in the Statement of Work for Order Number 11, Contract F33615-D-4003.

The purpose of the field program at Reese AFB Texas was:

- To determine the presence or absence of contamination within the specified areas of investigation;
- To determine, if possible, the magnitude of contamination and the potential for contaminant migration within the various environmental media; and
- To identify significant public health and environmental hazards associated with the migrating contaminants based upon state and federal standards.

Elements of the field program included: geophysical surveys, sediment sampling, subsurface soil sampling, surface water sampling, installation of monitoring wells, and sampling of groundwater.

3.2 FIELD INVESTIGATION

The field investigation consisted of:

- Literature search;
- Magnetometer and electromagnetic (EM) terrain conductivity surveys (30,200 linear feet and 32,980 linear feet, respectively);
- A soil gas survey;
- Drilling of 35 boreholes (4 converted to monitoring wells);
- Surface completion of five existing wells; and
- Collection and analysis of 11 sediment samples, 107 subsurface soil samples, 8 surface water samples, 14 groundwater samples, and, 27 EP toxicity/ignitability samples.

3.2.1 Schedule of Field Activities

Scheduling of field activities was designed to optimize the utilization of manpower and resources to provide the most efficient accomplishment of the project objectives. Field activities were coordinated with the USAFOEHL, the base Point of Contact (POC), and subcontractors to minimize delays and potential problems.

Throughout the course of the field activities, daily contact was maintained with the designated base personnel. The principal contact was 2nd Lt. Greg Zigulis or his designate, Senior Master Sgt. John Tice of Bioenvironmental Engineering Services. In addition, close coordination was maintained with representatives of the Civil Engineering Squadron. The following is a list of principal Reese AFB personnel contacts:

- 2nd Lt. Greg Zigulis--Bioenvironmental Engineering Services (designated POC)
- Senior Master Sgt. John Tice--Bioenvironmental Engineering Services

- Mr. Scott Shepherd--Base Planner, Civil Engineering Squadron
- Lt. Mark Stuart--Civil Engineering Squadron
- Cpt. Mike Keller--Civil Engineering Squadron

The field effort was completed in three segments between June 24, 1986, and October 14, 1986. Table 3-1 provides the sequential schedule of major field activities.

Health and safety protocols as outlined in the Health and Safety Plan (see Appendix N) were followed throughout the project. Modification to specific elements of the Health and Safety Plan was based upon field conditions and was executed only after discussion with E & E's Health and Safety Coordinator.

3.2.2 Records Search

During the course of the Phase II Stage 1 investigation, a number of interviews were held with various personnel of the base Bioenvironmental Engineering Services and the Base Civil Engineering Squadron regarding historical waste disposal practices and potential contaminants. In addition, staff of the Texas Water Commission, the Texas Department of Health, and the High Plains Underground Water Conservation District I were interviewed regarding groundwater use and well locations.

Historical aerial photos of the base were examined to reconstruct waste disposal practices over the years. Photo access was provided by the Base Civil Engineering Squadron. Available photos were enlarged prints showing the entire base or portions thereof for various years from the early 1940s to the present.

A well survey was conducted of wells within a one-mile radius of Reese AFB to establish groundwater usage to identify potential contaminant exposure to the public and the subsequent impacts. Results of this survey were discussed in Section 2.8 of this report.

3.2.3 Geophysical Survey Procedures

Magnetometer and electromagnetic (EM) terrain conductivity geophysical techniques were used to locate and confirm the locations of waste burial sites. Since most landfills contain a greater amount of ferromagnetic (magnetically conductive) materials than surrounding materials, there is generally a measurable anomaly (variation) in the

Table 3-1

SCHEDULE OF MAJOR FIELD ACTIVITIES

June 22-23	Field effort mobilization and onsite coordination.
June 24-25	Reconnaissance of wells at Area 008. Sample locations staked at Areas 001, 002, 004, and 006.
June 26	Soil sediment samples taken from Areas 001, 002, and 006.
June 27 - July 1	Geophysical survey (EM & Magnetometer) at Areas 002, 004, 007, and 008.
July 2	Demobilization.
July 22-23	Field effort mobilization and onsite coordination
July 24	Soil sampling from Area 009.
July 25	Drillers arrive, mobilization.
July 26-27	No activity.
July 28-30	Drillers set up decontamination area. Borings and monitor well installion at Area 001.
July 31	Borings at Area 004.
August 1	Monitor well at Area 001 developed.
August 2	Monitor well installation Area 005.
August 3	Borings at Area 003.
August 4	Monitor well at Area 005 completed. Drums staged.
August 5	Monitor well installation Area 004. Borings at Area 007.
August 6	Drums staged and borings grouted.
August 7	Sediment sample from Area 001 and water samples from Area 002 collected.
August 8	Review historical aerial photos.
August 9-10	No activity.
August 11	Sediment sample Area 002 collected. Well 004 developed. Borings on Area 006.

Table 3-1 (Cont).

August 12	Pad and casing protector installed on monitoring wells at Areas 001 and 004. Borings at Area 008.
	Borings complete auger crew demobilizes.
August 13-17	Monitor well installation Area 002. Drums staged, borings grouted.
August 18-19	Purge and sample wells 1-5 at Area 008.
August 20	Purge and sample wells at Areas 001, 002, and 004.
August 21	Cement pads installed at wells 1 and 3 at Area 008. Borings at Area 008 grouted.
August 22	Demobilization.
September 23	Mobilization for second round of water sampling. Began location and elevation survey. Began drummed waste disposal.
September 24-26	Collected water samples from Areas 001, 002, 004, and 005.
September 26	Completed drummed waste disposal.
October 7	Completed location and elevation survey.
October 13-14	Conducted well survey within 1 mile radius of base. Completed field effort.

magnetic flux associated with the landfill. Also, conductive and non-conductive fluids are present in soils, and such natural conductivities are altered when they are disturbed by excavation. Therefore, landfills will exhibit variations from the earth conductivity of undisturbed soils.

Magnetometer and EM surveys were performed at the East Landfill, North Landfill (Area 002); the Southwest Landfill (Area 004); and the Hurlwood Acquisition and Landfill (Area 008). Only an EM survey was performed at Area 007 (the Northwest Landfill) due to a lack of magnetic variation. Figure 3-1 shows the areas of geophysical surveys. Both surveys were conducted simultaneously so that manpower and time would be most effectively utilized. The primary purpose of these surveys was to define the limits of inactive landfills and associated trenches. Borings and wells were located to optimize environmental information while avoiding penetration of buried wastes.

A discussion of the basic survey procedure follows. A Geometrics Model G-846 proton precession magnetometer with a sensitivity of 0.1 gammas; and, a Geonics Model EM-31 Terrain Conductivity Meter with an effective exploration depth of 6 meters were used for the survey.

The initial step in performing the surveys was the staking of the grid system. This grid was designed to cover an adequate area extending beyond the expected landfill boundaries so adequate variation from background could be expected and used to define the limits of the landfills. Stations were established on the grid at measured intervals. The standard grid intervals were 100 feet by 100 feet. Each 100 feet was flagged with surveyor's tape. Actual points of readings during the survey were at distances estimated between the measured stations. A base point was established at each site so that a background level and natural variations in magnetic intensity and conductivity could be monitored throughout the survey. Periodic measurements were taken at the base point (usually at the end of every second traverse).

Traverses were made with the magnetometer and the EM meter. Three readings were taken with the magnetometer every 25 feet and averaged. This provided monitoring of the natural variations in the magnetic intensity. Readings were also taken at the same station with

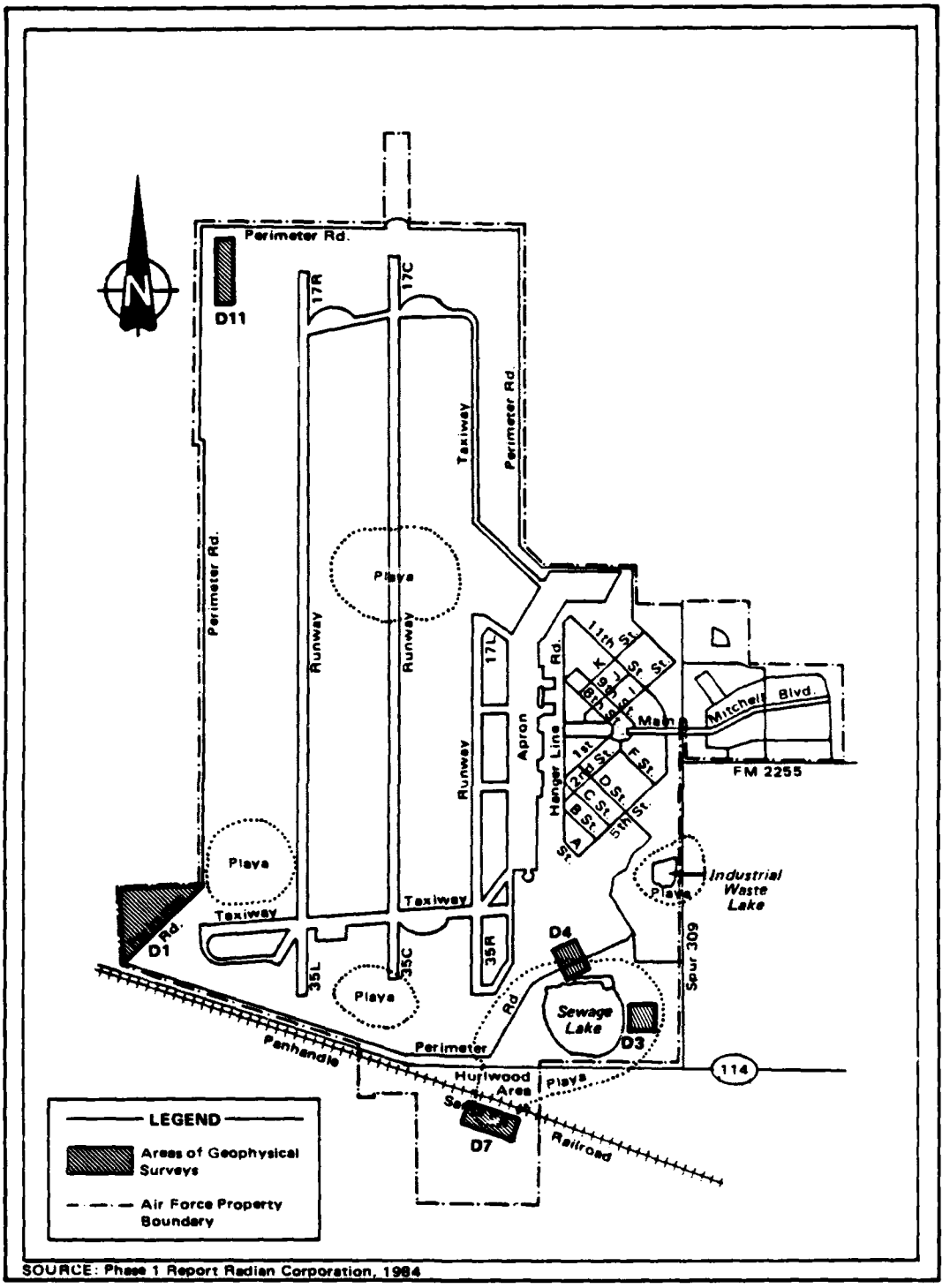


Figure 3–1 AREAS OF GEOPHYSICAL SURVEYS

the EM meter. Data obtained were recorded, analyzed, and used to allow the locating of borehole and well locations.

Table 3-2 summarizes the geophysical surveys at each area. Survey data are presented in Appendix I. Results of the surveys are discussed in Section 4.1 of this report.

3.2.4 Soil Gas Sampling

At the POL Storage Area (Aquasystem) Spill Site (Area 003) a soil gas survey was performed to identify the potential remnant contamination from a previous fuel spill. The survey was performed by hand augering a series of 24 holes on a 25-foot by 35-foot grid to a depth of 3 feet. Slotted PVC pipe was installed in each hole and the hole sealed. After allowing the hole to stand for about 30 minutes, each hole was monitored using a Organic Vapor Analyzer to determine the presence or absence of volatile compounds. The results of this survey are discussed in Section 4.1 of this report.

3.2.5 Sampling Procedures

All samples collected were split in the field. Split samples were delivered to the POC. The POC determined those splits which were to be submitted to OEHL/SA for analysis. The split samples for analysis were provided by the POC to E & E for shipment to OEHL/SA.

Sediment Sampling

Sediment sampling was conducted in association with the Industrial Waste Lake (Area 001); the Sewage Lake and associated landfill sites (Area 002); and Active Fire Training Area (Area 006). Eleven sediment samples were collected and submitted for chemical analysis. Table 3-3 presents a summary of the samples collected. Locations of the samples are shown in Figure 3-2 (see pocket in back of this report).

Sediment samples from the lake inlet delta and rainwater drainage channel at Area 001 and from the low flow discharge area of the polishing lake and the sewage plant discharge point at Area 002 were collected using a stainless steel beaker attached to metal poles. The beaker was raked across the bottom sediments. The collected sediments were composited and apportioned to the appropriate sample containers.

Table 3-2

GEOPHYSICAL SURVEY SUMMARY

Area	Landfill*	EM Survey (feet)	MAG Survey (feet)	Station Interval (feet)
002	D-3	4,025	4,025	25
	D-4	5,000	5,000	25
004	D-1	17,925	17,925	25
007	D-11	2,780	--	25
008	D-7	3,250	3,250	25

*Air Force designation

Table 3-3

SEDIMENT SAMPLE SUMMARY

Area No.	Field Sample No.	Coordinates		Sample Location Description
		Northing	Easting	
001	9001/9002*	728,402.658	621,634.843	Lake inlet delta
	9003	728,545.481	622,015.619	Drainage channel along Spur 309 between picnic area and golf course
	9004	727,311.771	621,176.311	Roadside ditch southwest of golf green #2
	9007	728,099.376	621,932.508	Lake bottom at southern end of lake
002	9025	726,486.617	620,807.312	Sewage plant discharge
	9026	726,371.081	620,196.406	Low flow area at outlet to discharge channel
	9027	725,998.804	620,818.571	Lake bottom (0 - 1') at eastern end of lake
	9028	725,998.804	620,818.571	Lake bottom (1 - 2') at eastern end of lake
006	9047	728,731.570	614,942.939	0 - 6" depth from sump outlet drainage
	9048	728,727.707	615,045.640	0 - 6" depth from natural depression

*Duplicate QA/QC samples

Sediment samples from the drainage associated with Areas 001 and 006 and the playa at Area 006 were collected from 0 to 6 inches in depth using trowels which were disposed of after collection of each sample. Each trowel of sediments was equally divided and introduced directly into the sample containers.

Lake bottom sediment samples from Areas 001 and 002 were collected using a Wildco Bottom Core Sampler. The obtained samples were composited in stainless steel mixing bowls and placed in the appropriate sample containers.

All sampling equipment with the exception of the trowels, which were disposed of, were decontaminated after each sample by washing in detergent and trisodium phosphate, rinsing with potable water, methanol, and distilled water as outlined in the Technical Operations Plan (TOP) (see Appendix N).

Subsurface Soil Sampling

Subsurface soil samples were collected from split-spoon samples retrieved during the drilling of the boreholes or monitor wells. Borehole and monitor well drilling were performed by Environmental Drilling Company of Tulsa, Oklahoma. Table 3-4 summarizes the depths of each borehole. Borehole locations are shown on Figure 3-2 (see back pocket).

Ninety-five subsurface soil samples were collected and submitted for analysis during the drilling of 31 boreholes. These boreholes were drilled for the specific purpose of obtaining subsurface soil samples. Four additional boreholes were drilled and converted to monitoring wells. A total of 534.2 linear feet of borehole drilling was accomplished using a Mobile B-53 drilling rig equipped with continuous-flight hollow-stem augers. All samples were retrieved using an 18-inch split-spoon sampler. Sample collection was in accordance with ASTM D-1856-67. Boreholes were completed to depths of 30 feet or refusal. Refusal was determined to be that point at which the split-spoon sample could be driven less than 6 inches per fifty hammer blows or that depth at which the augers could no longer penetrate the subsurface material.

Samples from the boreholes were collected at 5-foot intervals throughout the total depth of the boring. These samples were used for

Table 3-4

BORING DEPTH SUMMARY

Site No.	Boring Designation	Total Depth (ft)
001	001-B1	30.0
	001-B2	23.0
	001-B3	23.5
	001-W1	176.0
002	002-B1	21.0
	002-B2	20.5
	002-B3	20.5
	002-W1	180.0
003	003-B1	19.5
	003-B2	28.5
	003-B3	19.0
	003-B4	20.7
004	004-B1	31.5
	004-B2	21.0
	004-B3	31.5
	004-W1	185.0
005	005-W1	133.0
006	006-B1	26.5
	006-B2	23.5
007	007-B1	18.5
	007-B2	31.5
	007-B3	31.5
	007-B4	28.5
008	008-B1	25.5
	008-B2	18.5
009	009-B1 to 009-B10	All 2

determining the stratigraphic sequence of materials penetrated. The samples were logged and archived for future reference if needed. Logs of each boring are presented in Appendix D.

The contract recommended depths from which retrieved samples should be selected for chemical analysis. These recommendations were used as a guide. Each sample was visually inspected and monitored with an OVA to detect the presence of volatile organics. Based upon the inspection and the nature of the materials encountered and the depth to refusal, a final decision was made as to the selection of samples to be submitted for analysis. Table 3-5 shows the contract recommended sample depths and the actual depths from which the samples were submitted for analysis.

Upon completion of the drilling and sampling of the borings, each boring was grouted to the surface. The grout plug serves as a permanent location marker.

Sampling equipment was decontaminated between each sample. The drill rig and augers were decontaminated between each site. Decontamination procedures followed those outlined in the TOP.

Twelve subsurface soil samples were collected and submitted for analysis during the total of 674.0 linear feet of drilling of four boreholes which were converted to monitoring wells. Monitor well drilling was accomplished using a Failing 1500 air/mud drill rig. Drilling was aided by the circulation of bentonite drilling fluid. Use of drilling fluid was necessary for hole stabilization during drilling. Depths of the wells were determined based upon the contract requirements and the field conditions encountered during drilling.

Samples for stratigraphic analysis were retrieved from cuttings collected at each 5-feet of penetration throughout the total depth of the well. Samples were logged and archived for future reference. Logs of each monitor well are presented in Appendix D.

The contract recommended depths from which samples should be submitted for analysis. Samples from these depths were retrieved using a split-spoon sampler. The sampler was pushed through the sample depth with the rig. Not all the recommended samples could be collected because the formation hardness precluded penetration of the sampler.

Sampling equipment was decontaminated between each sample. The drill rig and drill rods were decontaminated between each site. Decontamination procedures followed those outlined in the TOP.

Table 3-5

STATEMENT OF WORK/ANALYZED SUBSURFACE SOIL SAMPLES

Area	Boring/ Well**	Contract-Recommended Sample Depth (feet)	Actual Sample Depth (feet)	Sample Number
001	Boring 1	3	5 - 6.5	9012
		15	15 - 16.5	9013
		30	28.5 - 30.0	9014, 9041*
	Boring 2	3	1 - 2.5	9015
		15	15 - 16.5	9016
		30	21.5 - 23.0	9017
	Boring 3	3	5 - 6.5	9018
		15	15 - 16.5	9019
		30	22 - 23.5	9020
	Well 1	3	0 - 3	9021
		15	15	9022
		30	30	9023
		50	50	9024
		Capillary zone	No sample***	--
002	Boring 1	3	5 - 6.5	9033
		15	15 - 16.5	9034
		30	20 - 21.0	9035
	Boring 2	3	1 - 2.5	9036
		15	15 - 16.5	9037
		30	19 - 20.5	9038
	Boring 3	3	1 - 2.5	9039
		15	15 - 16.5	9040
		30	No sample	--
	Well 1	3	3	9042
		15	15	9043
		30	No sample	--
		50	No sample	--
		Capillary zone	No sample	--
003	Boring 1	3	5 - 6.5	9057
		10	10 - 11.5	9058
		15	15 - 16.5	9059
		20	17 - 19.5	9060
		30	No sample	--
	Boring 2	3	5 - 6.5	9061
		10	10 - 11.5	9062
		15	15 - 16.5	9063
		20	20 - 21.5	9064
		30	27 - 28.5	9143, 9150*
	Boring 3	3	5 - 6.5	9065
		10	10 - 11.5	9066
		15	15 - 16.5	9067
		20	17.5 - 19.0	9068
		30	No sample	--
	Boring 4	3	5 - 6.5	9069
		10	10 - 11.5	9070
		15	15 - 16.5	9071
		20	No sample	--
		30	No sample	--

Key at end of table.

Table 3-5 (Cont.)

Area	Boring/ Well**	Contract-Recommended Sample Depth (feet)	Actual Sample Depth (feet)	Sample Number
004	Boring 1	3	1 - 2.5	9075
		15	15 - 16.5	9076
		30	30 - 31.5	9077
	Boring 2	3	5 - 6.5	9078
		15	15 - 16.5	9079
		30	19.5 - 21	9080
	Boring 3	3	5 - 6.5	9081
		15	15 - 16.5	9082
		30	30 - 31.5	9083, 9142*
	Well 1	3	3	9084
		15	15	9085
		30	30	9086
005	Well 1	3	3	9090
		15	15	9091
		30	30	9092
		50	No sample	--
		Capillary zone	No sample	--
006	Boring 1	3	5 - 6.5	9049
		15	13 - 16	9050, 9144*
		20	20 - 21.5	9051
		30	25 - 26.5	9052
		50	No sample	--
		Capillary zone	No sample	--
	Boring 2	3	5 - 6.5	9053
		15	15 - 16	9054
		20	20 - 21.5	9055
		30	No sample	--
007	Boring 1	3	5 - 6.5	9093
		15	15 - 16.5	9094
		30	17 - 18.5	9095
	Boring 2	3	5 - 6.5	9096
		15	15 - 16.5	9097
		30	30 - 31.5	9098
	Boring 3	3	5 - 6.5	9099
		15	15 - 16.5	9100
		30	30 - 31.5	9101
	Boring 4	3	5 - 6.5	9102
		15	15 - 16.5	9103
		30	25 - 28.5	9104, 9138*
008	Boring 1	3	1 - 2.5	9105, 9139*
		15	15 - 16.5	9106
		30	24 - 25.5	9107
	Boring 2	3	1 -.2.5	9108
		15	15 - 16.5	9109
		30	17 - 18.5	9110
009	Boring 1	0.5	0 - 1	9116
		2	1 - 2	9117, 9117*
	Boring 2	0.5	0 - 1	9119
		2	1 - 2	9120

Key at end of table.

Table 3-5 (Cont.)

Area	Boring/ Well**	Contract-Recommended Sample Depth (feet)	Actual Sample Depth (feet)	Sample Number
009 (Cont.)	Boring 3	0.5	0 - 1	9121
		2	1 - 2	9122
	Boring 4	0.5	0 - 1	9123
		2	1 - 2	9124
	Boring 5	0.5	0 - 1	9125
		2	1 - 2	9126
	Boring 6	0.5	0 - 1	9127
		2	1 - 2	9128
	Boring 7	0.5	0 - 1	9129
		2	1 - 2	9130
	Boring 8	0.5	0 - 1	9131
		2	1 - 2	9132
	Boring 9	0.5	0 - 1	9133, 9134*
		2	1 - 2	9135
	Boring 10	0.5	0 - 1	9136
		2	1 - 2	9137

*Indicates QA/QC duplicate sample.
**See Figure 3-2 (back pocket) for location of borings and wells.
***"No sample" entries were the result of formation hardness which precluded the collection of a sample at that location.

Sampling equipment was decontaminated between each sample. The drill rig and drill rods were decontaminated between each site. Decontamination procedures followed those outlined in the TOP.

Twenty-two shallow (0-2 feet) subsurface soil samples were collected at the Sewage Sludge Spreading Areas (Area 009) and submitted for analysis. These samples were retrieved by collecting and compositing cuttings from 0 to 1 foot and 1 to 2 feet depths. Borings were completed using a hand-held power auger. Cuttings were composited in a stainless steel bowl and transferred to the appropriate sampling container. Table 3-5 summarized the samples collected. Locations are shown on Figure 3-2 (see back pocket).

Augers and sampling equipment were decontaminated between samples. Decontamination procedures followed those outlined in the TOP.

Surface Water Sampling

Surface water samples were collected from the lakes at Areas 001 and 002 (the Industrial Waste Lake and Sewage Lake sites). Each location was sampled twice. Eight surface water samples were collected for analysis. Table 3-6 summarizes the surface water sampling locations. Sample locations are shown on Figure 3-2 (see back pocket).

Surface water samples were collected by using a stainless steel beaker attached to metal poles. The collected water was composited and apportioned to the appropriate sample containers. A small amount of volatile organics would be lost when compositing samples, but not enough to significantly affect the analytical results.

Sampling equipment was decontaminated after each sample. Decontamination procedures followed those outlined in the TOP.

Monitor Well Installation and Groundwater Sampling

Four monitoring wells were installed at four areas on Reese AFB. Monitoring well casings and screens were 4-inch Schedule 80 polyvinyl chloride (PVC). Table 3-7 provides a summary of well construction details. Well construction diagrams and borehole logs are presented in Appendix D. The screen and casing were set in an approximately 10-inch diameter borehole. The annular space was filled with clean washed coarse sand, which was tremied into place, to a depth of about

Table 3-6

SURFACE WATER SAMPLE LOCATION SUMMARY

Area No.	Field Sample No.	Coordinates		Sample Date	Sample Location Description
		Northing	Easting		
001	9005/9006*	728,074.232	621,791.823	6-6-86	Pump inlet - south side of lake
	9008/9009*	728,074.232	621,791.823	9-26-86	Pump inlet - south side of lake
002	9029	726,331.489	620,850.210	8-7-86	Polishing lake discharge
	9044	726,331.489	620,850.210	9-26-86	Polishing lake discharge
	9030	726,440.737	620,280.736	8-7-86	Pump inlet - northeast corner of lake
	9045	726,440.737	620,280.736	9-26-86	Pump inlet - northeast corner of lake

*Duplicate QA/QC samples

Table 3-7

SOIL BORING AND MONITORING WELL LOCATION, ELEVATION, AND DESIGN DATA

Area No.	Boring and/or Well I.D.	Coordinates*		Elevation		Total Depth (feet)	Well Construction Data					
		Northing	Easting	Ground	Top of PVC Casing		Sump (ft)	Screen (ft)	Sand Pack (ft)	Bentonite (ft)	Grout (ft)	Casing/Screen Diameter (in)
001	001-B1	728,565.966	621,924.266	3,300.14	--	30.0	--	--	--	--	30.0 - surface	--
	001-B2	728,467.142	621,668.370	3,300.29	--	23.0	--	--	--	--	23.0 - surface	--
	001-B3	728,147.839	621,642.354	3,299.38	--	23.5	--	--	--	--	23.5 - surface	--
	001-W1	728,100.817	621,951.571	3,299.75	3,301.64	176.0	176 - 171	171 - 141	176 - 128	128 - 119	119.0 - surface	4.0
002	002-B1	726,375.676	620,092.020	3,298.52	--	21.0	--	--	--	--	21.0 - surface	--
	002-B2	725,989.803	619,768.337	3,294.08	--	21.0	--	--	--	--	21.0 - surface	--
	002-B3	725,716.965	619,783.063	3,293.76	--	20.5	--	--	--	--	20.5 - surface	--
	002-W1	725,611.146	620,920.314	3,294.90	3,296.74	180.0	180 - 170	170 - 140	180 - 128	128 - 121	121.0 - surface	4.0
003	003-B1	728,156.535	619,841.907	3,328.67	--	19.5	--	--	--	--	19.5 - surface	--
	003-B2	728,249.757	619,817.473	3,327.06	--	28.5	--	--	--	--	28.5 - surface	--
	003-B3	728,187.347	619,987.302	3,326.97	--	19.0	--	--	--	--	19.0 - surface	--
	003-B4	728,099.689	619,988.880	3,327.35	--	21.5	--	--	--	--	21.5 - surface	--
004	004-B1	728,019.453	612,744.448	3,331.49	--	31.5	--	--	--	--	31.5 - surface	--
	004-B2	728,194.756	613,362.330	3,330.12	--	21.0	--	--	--	--	21.0 - surface	--
	004-B3	727,782.652	613,731.066	3,331.72	--	31.5	--	--	--	--	31.5 - surface	--
	004-W1	727,320.688	612,871.296	3,336.59	3,338.64	185.0	185 - 175	175 - 165 145 - 125	185 - 114	114 - 104	104.0 - surface	4.0
005	005-W1	728,743.561	620,853.439	3,318.84	3,318.67	133.0	132 - 127	127 - 97	132 - 80	80 - 68	68.0 - surface	4.0
006	006-B1	728,453.344	614,827.123	3,311.74	--	28.0	--	--	--	--	28.0 - surface	--
	006-B2	728,701.437	614,474.615	3,310.91	--	23.5	--	--	--	--	23.5 - surface	--
007	007-B1	739,381.027	614,713.635	3,329.16	--	18.5	--	--	--	-	18.5 - surface	--
	007-B2	739,390.990	614,581.297	3,329.64	--	31.5	--	--	--	-	31.5 - surface	--
	007-B3	738,889.204	614,704.167	3,332.27	--	31.5	--	--	--	--	31.5 - surface	--
	007-B4	739,032.859	614,557.788	3,331.64	--	28.5	--	--	--	--	28.5 - surface	--
008	008-B1	723,988.712	619,174,953	3,306.50	--	25.5	--	--	--	--	25.5 - surface	--
	008-B2	724,389.963	618,818,577	3,313.34	--	18.5	--	--	--	--	18.5 - surface	--
	008-W1	723,330.920	618,134.794	3,316.88	3,319.37**	158.5***	Data not available†					10.0
	008-W2	724,230.482	618,496.092	3,315.12	3,318.15**	139.5***	Data not available					6.9
	008-W3	724,755.690	619,146.289	3,311.20	3,314.03**	159.0***	Data not available					6.0
	008-W4	724,714.761	616,741.089	3,318.13	3,321.15**	170.0***	Data not available					6.5
	008-W5	725,075.491	616,770.738	3,318.86	3,321.57	161.0***	Data not available					16.0
009	009-B1	730,236.922	620,685.239	3,324.87	--	2.0	--	--	--	--	--	--
	009-B2	730,141.744	620,509.794	3,324.56	--	2.0	--	--	--	--	--	--
	009-B3	730,030.513	620,366.233	3,324.26	--	2.0	--	--	--	--	--	--
	009-B4	729,919.110	620,241.863	3,324.40	--	2.0	--	--	--	--	--	--
	009-B5	729,780.544	620,421.988	3,323.88	--	2.0	--	--	--	--	--	--
	009-B6	729,874.423	620,406.448	3,324.18	--	2.0	--	--	--	--	--	--
	009-B7	729,872.224	620,490.846	3,323.95	--	2.0	--	--	--	--	--	--
	009-B8	729,943.639	620,488.893	3,324.18	--	2.0	--	--	--	--	--	--
	009-B9	729,922.055	620,566.936	3,323.85	--	2.0	--	--	--	--	--	--
	009-B10	730,131.306	620,685.211	3,324.11	--	2.0	--	--	--	--	--	--

*Coordinates are in accordance to the Lamberd Grid Texas North Central Zone
**Elevation is top of steel casing
***Total depth below top of casing

†Pre-existing wells. No construction data were available.

10 feet above the top of the screen. A 5-foot seal of bentonite was placed on top of the sand pack. The remaining annular space to the ground surface was tremie-filled with Volclay grout. Well protection was provided by 8-inch diameter steel casing with a locking slip type cap installed around the PVC casing. The surface of the wells were finished with a 2- by 3-foot by 10-inch deep concrete pad. Wells located in areas of mowing or traffic were also fitted with three protective posts set into the concrete pad.

The exception to the above was the well at the Civil Engineering Paint Shop Trench (Area 005). As a result of current construction activities, the surface of this well was finished flush with the ground surface so that access to the construction site would not be impeded. Installation of this well is further discussed later in this section (see Subsection 3.2.10).

There were five existing wells at the Hurlwood Aquisition (Area 008.) These wells were inactive and had been cut off flush with the ground surface. Tne diameter of the wells varied. Four of the wells had steel casing while one had PVC. Information regarding these wells is presented in Table 3-7. As part of Phase II work, each well was completed by extending the existing casing above the ground surface by welding a casing extension to the existing casing and fitting the casing with a locking cap. The PVC well had a PVC extension and a protective steel casing with locking cap added. Those wells not already having a concrete pad at the surface were completed with one. Each well was equipped with a dedicated Teflon bailer.

A total of 13 groundwater samples were collected from the nine wells and submitted for analysis. The five wells at Area 008 were sampled one time. Each of the four wells on the base was sampled twice. Table 3-8 summarized the groundwater sampling. Prior to the sampling of the monitoring well, each well was purged of three to four well volumes to assure the sample collected was representative of actual groundwater quality. Purging was accomplished using a submersible pump. The well at Area 005 was the exception; it was purged using a bailer. The actual sample was collected using a Teflon bailer and monofilament line. The water was composited and apportioned to the appropriate sample container.

Table 3-8

GROUNDWATER SAMPLING SUMMARY

Area No.	Field Sample No.	Sample Date	Sample Description	Purging Data: Depth Below Top of Casing (feet)	Purging Data: Water Level Below Top of Casing (feet)	Purging Data: Casing Diagram (in.)	Purging Data: Volume of Water Column (gal.)	Purging Data: Volume Purged (gal.)	Physical Data[3]: pH	Physical Data[3]: Condition (umh/cm)	Physical Data[3]: Temperature °C
001	9010	8/20/86	Well 001-W1	177	103.08	4	49.5	240	7	1200	19
	9011	9/25/86	Well 001-W1	177	103.20	4	44.3	192	8.49	474	22.4
002	9031	8/20/86	Well 002-W1	181.5	97.67	4	56.1	232	7	1200	18
	9032	9/25/86	Well 002-W1	181.5	95.0	4	57.9	200	7.85	1234	22.9
004	9073	8/20/86	Well 004-W1	187.5	129.19	4	39.1	300	7	1300	20
	9074	9/25/86	Well 004-W1	187.5	128.9	4	39.3	170	6.80	2020	23.2
005	9088/9089[1]	8/17/86	Well 005-W1	133	116.63	4	10.9	12[2]	8	1750	26
	9140	9/26/86	Well 005-W1	133	120.28	4	8.5	15[2]	6.60	1303	19.6
008	9111	8/18/86	Well 008-W1	158.5	129.87	10	116.8	380	7	1400	23
	9112	8/18/86	Well 008-W2	139.5	126.74	6.9	25.5	130	7	1350	23
	9113	8/18/86	Well 008-W3	159	121.44	6	56.3	240	7	1220	21
	9114	8/19/86	Well 008-W4	170	122.73	16	496.3	744	7	1290	17
	9115	8/19/86	Well 008-W5	161	123.38	6.5	63.9	384	7	1100	18

[1] QA/QC duplicate samples.
[2] Well purged with bailer until no water could be bailed.
[3] Instrumentation used for sampling differed between sampling rounds.

Since each well was equipped with a dedicated bailer, no decontamination of sampling equipment was necessary between samples. The stainless steel container used for compositing was decontaminated between each sample in accordance with procedures outlined in the TOP.

3.2.6 Location and Elevation Survey

Upon completion of the drilling and sampling effort, the location of each sampling point was determined. Also, the elevation of each boring and well was determined. Locations were determined to an accuracy of 1 foot, while the elevation accuracy was 0.01 foot. Surveying was done by a Registered Surveyor in the State of Texas. Location and elevation data are presented on Figure 3-2 (see back pocket). A copy of the field notes, survey closure data, and the longitude/latitude data are provided in Appendix E.

3.2.7 Investigation-Derived Waste Handling

Drill cuttings and drilling fluids were containerized in 55- gallon, reconditioned, DOT-approved drums. In accordance with the SOW, since no evidence of contamination based upon visual observation or volatile release was noted, a sample of material from one drum from each borehole was submitted for EP toxicity and ignitability testing. A total of 27 samples, including QA/QC, were submitted for analysis. Table 3-9 lists the site and number of the waste samples collected and submitted for analysis. Those wastes which tested clean, in accordance with the SOW and in coordination with the base Civil Engineering Squadron, were disposed in the clean concrete and earth landfill at Area 004.

Waters derived from the purging of the monitoring wells were containerized in a similar manner to the drilling wastes. The disposal of the water wastes was dependent upon the analysis of the groundwater samples. Waters associated with those wells which tested acceptable were disposed of in accordance with directions from the base Civil Engineering Squadron.

3.2.8 Site-Specific Investigation Activities

Table 3-10 summarizes site-specific field investigation activities conducted. Figure 3-2 (see back pocket) shows each sample location and provides locational data.

Table 3-9

EP TOX SAMPLES TAKEN

Sample #	Description
9163	001-B_1, Drum
9162	001-B_3, Drum
9160	001-W, Drum
9161	001-B_2, Drum
9164	002-B_1, Drum
9165	002-B_2, Drum
9166	002-B_3, Drum
9183	002-W_1, Drum
9168	003-B_1, Drum
9171	003-B_2, Drum
9174	003-B_2, Drum
9172	003-B_3, Drum
9173	003-B_4, Drum
9168	004-B_1, Drum
9170	004-B_2, Drum
9167	004-B_3, Drum
9174	004-W_1, Drum
9169	005-W_1, Drum
9179	006-B_1, Drum
9180	006-B_2, Drum
9175	007-B_1, Drum
9176	007-B_2, Drum
9177	007-B_3, Drum
9178	007-B_4, Drum
9179	007-B_4, Drum
9181	008-B_2, Drum
9182	008-B_1, Drum

Table 3-10

SUMMARY OF SITE-SPECIFIC FIELD ACTIVITIES

Area No.	Field Activity
001	14 subsurface soil samples from 4 borings 1 boring converted to a monitoring well 2 groundwater samples collected from well 4 surface water samples from lake 5 sediment samples from lake and drainages 4 EP toxicity/ignitability samples from drummed drill cuttings
002	9,025 linear feet of geophysical survey on D-3, and D-4, 10 subsurface soil samples from 4 borings 1 boring converted to a monitoring well 2 groundwater samples from well 4 surface water samples from lake 4 sediment samples from lake 4 EP toxicity/ignitability samples from drummed drill cuttings
003	17 subsurface soil samples from 4 borings 5 EP toxicity/ignitability samples from drummed drill cuttings Soil gas survey
004	17,925 linear feet of geophysical survey 13 subsurface soil samples from 4 borings 1 boring converted to a monitoring well 2 groundwater samples from well 4 EP toxicity/ignitability samples from drummed drill cuttings
005	3 subsurface samples from 1 boring converted to a monitoring well 3 groundwater samples from well 1 EP toxicity/ignitability sample from drummed drill cuttings
006	8 subsurface soil samples from 2 borings 2 sediment samples from drainages 2 EP toxicity/ignitability samples from drummed drill cuttings
007	2,780 linear feet of geophysical survey 13 subsurface soil samples from 4 borings 5 EP toxicity/ignitability samples from drummed drill cuttings
008	3,250 linear feet of geophysical survey 7 subsurface soil samples from 2 borings 5 groundwater samples from 5 wells 2 EP toxicity/ignitability samples from drummed drill cuttings
009	22 subsurface soil samples from ten borings

3.2.9 Laboratory Program

All samples were split in the field, and 10 percent of the split samples were submitted to USAFOEHL/SA at Brooks Air Force Base, Texas. Field collection, preservation, packaging, and shipping protocols were followed as specified in the Technical Operations Plan (see Appendix N).

Copies of the chain-of-custody forms for the samples are provided in Appendix G. Information on detection limits for the analytical parameters is given in Table 1-2. Additional information on holding times can be found with the analytical data in Appendix H. All samples were shipped to the E & E Analytical Services Center or to USAFOEHL/SA by Federal Express. Analytical protocols are discussed in Appendix N.

3.2.10 Variations From Description of Work

During the execution of the field effort, several changes from the Description of Work were implemented due to field conditions and findings. Changes were implemented after discussion with and concurrence of OEHL. A summary of the variations follows:

- A Volclay grout was used for the grouting of the annulus space of the monitoring wells and for the grouting of the borings in lieu of the Portland grout called for in the Description of Work. The Volclay grout provides a more competent seal and thus greater protection from potential surface contamination.

- In lieu of new 55-gallon drums, as called for in the Description of Work, reconditioned drums were used. Appendix F is a letter from the supplier stating the prior usage and cleanliness of the drums used.

- Several soil samples could not be retrieved from some borings due to the hardness of the formation. Samples called for but not collected are shown in Table 3-5. Table 3-11 is a summary of the number of soil and water samples analyzed for each analyte and a comparison to the contracted sample numbers.

Table 3-11

COMPARISON OF CONTRACTED AND ANALYZED SAMPLES

Parameter	Soil		Water	
	Contracted	Analyzed	Contracted	Analyzed
Purgeable Organics	204[1]	191[1,2]	28[1]	40[1]
Pesticides	64[1]	37[1]	16[1]	16[1]
Base/Neutral/Acid Extractable Organics	82[1]	45[2]	28[1]	22
Oil & Grease	140	114[2,3]	19	22[4]
Petroleum Hydrocarbons	22	17[2]	--	--
Phenols	98[1]	27[5]	19	23[1,4]
Total Dissolved Solids	--	--	19	16
Arsenic	29	29	--	--
Cadmium	28	25	--	--
Chromium	61	54	--	--
Copper	22	22	--	--
Lead	61	54	--	--
Nickel	28	25	--	--
Zinc	28	25	--	--
Primary Metals:				
Antimony	15	11[3]	19	21[4]
Beryllium	15	11[3]	19	21[4]
Cadmium	15	15	19	21[4]
Chromium	15	15	19	21[4]
Copper	15	15	19	21[4]
Lead	15	15	19	21[4]
Nickel	15	15	19	21[4]
Silver	15	11[3]	19	21[4]
Thallium	15	11[3]	19	21[4]
Zinc	15	11	19	21[4]
EP Toxicity	39	27	--	--
Ignitability	39	27	--	--
% Solids	127	118		

[1] Sample numbers include second column confirmation

[2] Some soil samples were not collected as a result of field conditions, resulting in a decrease in number of samples analyzed (see Section 3.2.5 for discussion)

[3] See Section 3.2.10 for discussion

[4] Added water samples from Area 002 and a distilled water blank

[5] Phenols analysis deleted from soil samples on which BNA also analyzed

- The Description of Work called for the monitoring wells to be a maximum of 175 feet in depth. The well at Area 005 was completed to 133 feet based upon the interception of a water producing zone. The wells at Areas 002 and 004 were 180 and 185 feet deep, respectively. These were taken below the described maximum to a clay-confining bed. Adequate drilling footage was available as a result of the Area 005 well being only 133 feet deep.

- The well at Area 005 was completed flush with the ground as opposed to being completed above grade. Discussion between the Corps of Engineers, the building contractor (D.O. Thompson Construction Co. - Gerald Emerson, Foreman), and the Base Civil Engineering Squadron resulted in the determination to complete the well flush with the ground. Although this completion method presents some difficulty in maintaining adequate well protection, the alternative was to postpone completion of the well until the completion of the building construction.

- Two additional surface water samples were collected from Area 002 to further characterize the lake water. These samples were added as replacement for some of the soil samples which were not collected.

- Prior to sampling of the groundwater at Area 005, the well, due to a limited well capacity, was not purged at least three well volumes. Water was purged until the capacity was inadequate to continue.

- After completion of fieldwork, it was found that laboratory analysis of samples for primary metals (see Table 1-1) omitted four of the 10 metals listed in the contract. The metals omitted were arsenic, beryllium, silver, and thallium. All samples with the exception of four (9005, 9006, 9029, and 9030), from the first round of sampling, were still archived

at the laboratory. All samples requiring primary metals, with the exception of these four, were re-analyzed for the omitted metals. The four samples mentioned had been discarded since samples are retained for only 30 days after analysis. QA/QC protocol was not circumvented since the recommended holding time for primary metals analyses was not exceeded. Samples collected during the second round of sampling were analyzed for the complete list of primary metals. The four metals omitted in the first round of sampling were found to be not detected in the second round analyses results. The remaining metals analyzed from the two rounds were in close agreement. Upon discussion with OEHL, it was therefore decided that no re-collection of samples for analysis of the four metals was required.

- Oil and grease analysis were not completed on three soil samples, as required in the contract, from boring 1 at Area 005. This omission was the result of a clerical error.

- Two samples from Area 006 (9047 and 9048) had phenol analysis omitted. All remaining soil samples from Area 006 were analyzed for phenols. However, it should be noted that the GC analysis of the soils from Area 006 showed no organic contaminants from related fractions.

- USAFOEHL requested that a sample of the distilled water used in the field for decontamination purposes be submitted for analysis. The analysis included the complete suite of parameters for water in the contract.

- Holding times on four petroleum hydrocarbon soil samples, specifically samples 9057, 9058, 9059, and 9060, from boring 1 at Area 003 were exceeded by one day. However, the oil and grease analysis was also performed on these samples. Since oil and grease had been analyzed and since the holding time was only slightly exceeded, upon discussion with USAFOEHL, it was decided that resampling would not be required.

- Magnetometer survey conducted at Area 007 was modified. Attempts to obtain MAG data were inconclusive. After several traverses with the magnetometer, no variations in readings were obtained, therefore, the remainder of the survey was discontinued. It was felt that information obtained during the EM survey would sufficiently identify potential landfill areas.

- PAH for sample 9138 not done due to laboratory oversight.

- The holding time on one oil and grease sediment sample (Sample 9007, South Lake Bottom, Area 001) was exceeded by one day. The holding time for oil and grease is for water samples specifically and is used only as a self-imposed guide for soil and sediment samples. Therefore, it was not necessary to resample at this location.

- TDS analyses were not complete on two groundwater samples from Area 005 (9088 and 9089) due to a laboratory error.

4. RESULTS AND SIGNIFICANCE OF FINDINGS

The Phase II Stage 1 investigation was conducted to identify those areas on Reese AFB where contaminant sources and migration exist. A total of nine sites were investigated (see Figure 4-1, back pocket). The investigation included collection of soil, sediment, and water samples. Geophysical surveys were conducted at four of the areas. Table 1-1 shows the analytical parameters for each area for the various sample matrices. Results of the geophysical surveys and the laboratory analysis are discussed in Section 4.1. Significance of the findings are discussed in Section 4.2.

4.1 RESULTS

The following subsections present site-specific discussions of the results of the investigation. The tables in this section list numerical values for the analytical parameters only when the concentrations exceeded the method detection limit. All values listed in the tables have been rounded off to two significant figures. Complete laboratory reports showing all analytical data are presented in Appendix H.

As a basis of comparison, the concentration of inorganic compounds in water has been compared to primary and secondary drinking water standards to determine significant concentration levels. The basis for comparison of organic and certain heavy metal concentrations are Maximum Contaminant Limits (MCL) and Recommended Maximum Contaminant Limits (RMCL) as set forth by the USEPA. The basis for the standards and criteria are discussed in Appendix L. MCLs and RMCLs

have not been established for all of the compounds detected at Reese AFB. Phthalate esters are one class of compounds for which there is no MCLs or RMCLs. The criteria used as a basis of comparison for phthalate esters are EPA Recommended Water Quality Criteria (Little 1981). It should be stated, however, that the data used to establish these criteria are old and do not encompass the data found in more recent toxicological literature on the subject. It is recommended that these criteria be re-evaluated and alternative criteria, reflecting more recent data, be developed for future studies at Reese AFB. Standards and criteria which have been established are given in the analytical results tables in the following sections. Some inorganic background water quality data is available. These data show generally high fluoride and often high selenium levels.

In presenting results of soil and sediment analyses and discussing their significance, it was necessary to devise some means of distinguishing which concentrations merit consideration, since there are no federal or state standards or health criteria for soils and sediments.

In order to evaluate concentrations of metals which are in most cases natural soil and sediment constituents, values termed as "threshold" values were derived by examining the range of concentrations present in the soil and sediment samples analyzed. The sediment and soil concentrations designated as threshold concentrations are not legal standards or associated with health criteria. These concentrations serve in this report as delimiters to allow statistically based differentiation between natural concentrations and probable contaminant concentrations. No background samples were taken at the base to verify the threshold values used. These samples should be taken in future investigative work to adjust for local conditions, if necessary.

Several metals, namely chromium, copper, lead, and zinc were present in the majority of soil and sediment samples at detectable concentrations. For each of these metals, the threshold concentration was calculated to be the arithmetic mean of all detectable concentrations plus two standard deviations. Concentrations of these metals which exceeded the threshold values were denoted as anomalous relative to the majority of values. The other metals, namely arsenic, cadmium,

and nickel, and the general parameter oil and grease, were not detected in the majority of soil and sediment samples. In the case of these parameters, threshold concentrations were considered to be the detection limits because with so many indeterminate values, mean concentrations and standard deviations of these parameters could not be calculated. Therefore, any detectable concentrations of these parameters were noted as anomalous.

Review of the analytical Quality Assurance/Quality Control (QA/QC) data shows that the analytical results are acceptable. With some minor exceptions, which will be discussed in the site-specific sections below, all QA/QC criteria have been met.

Organic analysis of the water samples collected reveal the presence of two general contaminant groups, volatile solvents and phthalates. The presence of phthalates may be anomalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC. Nine of the 14 groundwater samples collected had quantifiable levels of toluene. The toluene concentration range for these nine samples was 0.47 ug/L to 6.8 ug/L. The highest concentration of toluene was found in a groundwater sample from well 1 at Area 002 (Sewage Lake). Methylene chloride, a typical laboratory contaminant, was detected in both the groundwater and the surface water samples. A maximum concentration of 110 ug/L of methylene chloride was detected in a surface water sample from Area 001 (Industrial Waste Lake); however, the concentration does not exceed the existing MCLs or RMCLs for this compound.

The range of quantifiable oil and grease concentrations from soil collected from the borings was 110 mg/kg to 4,600 mg/kg. Soils collected from Area 009 had the highest concentrations of oil and grease. The range of quantifiable oil and grease concentrations from sediment samples was 230 mg/kg to 12,000 mg/kg. An oil and grease concentration of 12,000 mg/kg was detected in a sediment sample from Area 001 (Industrial Waste Lake).

4.1.1 Area 001: Industrial Waste Lake

Fieldwork Results

The determination of the subsurface geology was based upon the soils collected during the drilling of the three boreholes and the one

monitoring well. The subsurface materials consist principally of tight dry clays and silts overlying caliche. Some thin sand layers were penetrated. The depth and nature of the caliche is variable, ranging from white to reddish in color. The depth to competent caliche varied from 20.6 feet to 38 feet. No water was encountered above the caliche. Materials below the caliche are interbedded silts, clays, and sands. Details of the materials encountered during the drilling are reported on the drill logs in Appendix D.

The groundwater level was determined from monitoring well W-1. The water level in the well, as measured from the top of the PVC casing, was 103.08 feet on August 20, 1986 and 103.20 feet on September 25, 1986. During development and purging the well showed good recharge. During purging the well was pumped at 10 gallons per minute.

Analytical Results

A summary of analytical results for Area 001 is presented in Tables 4-1, 4-2, and 4-3. Table 4-1 compares the compounds detected above the method detection limits for the soil samples to their respective sample locations. Table 4-2 compares the compounds detected above the method detection limits for the sediment samples to their respective sample locations. Table 4-3 compares the compounds detected above the method detection limits for the water samples to their respective sample locations.

Fourteen soil samples were collected and analyzed. Three of the 14 samples had an elevated concentration of oil and grease. The oil and grease concentration range for these three samples was 110 mg/kg to 530 mg/kg. Di-n-octyl phthalate was detected in one of the 14 samples and 4-4-DDT was detected in one of the samples. Methylene chloride, a typical laboratory contaminant, appeared in the blanks but was not detected in the soils.

Four sediment samples and one duplicate were collected and analyzed. One of the five samples showed no evidence of contamination. Oil and grease were detected in the remaining four samples. The oil and grease concentration range for these four sediment samples was 230 mg/kg to 12,040 mg/kg. The purgeable organics 1,1,1-trichloroethane, tetrachloroethene, trichloroethene, and total xylenes

Table 4-1

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 001 (INDUSTRIAL WASTE LAKE, SI-1)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No.: / Field No.:	B1 5-6.5' 5940 9012	B1 15-16.5' 5941 9013	B1* 28.5-30' 5942 9014	B1* 28.5-30' 5943 9141	B2 1-2.5' 5901 9015	B2 15-16.5' 5902 9016	B2 21.5-23' 5903 9017	B3 5-6.5' 5904 9018	B3 15-16.5' 5905 9019	B3 22-23.5' 5906 9020
Oil and Grease**		240	ND	ND	ND	530	ND	ND	ND	ND	110
Di-n-octyl phthalate		2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-4'-DDT		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4-1 (Cont.)

	W1 0-3' 5907 9021	W1 15' 5908 9022	W1 30' 5909 9023	W1 50' 5910 9024	Method Detection Limit (mg/kg)
Oil and Grease**	ND	ND	ND	ND	100
Di-n-octyl phthalate	ND	ND	ND	ND	1
4-4'-DDT	ND	ND	3.2	ND	1.0

*QA/QC duplicate samples
**Concentration in mg/kg
ND - Not detected above method detection limit

Table 4-2

SUMMARY OF SEDIMENT SAMPLE ANALYSES FOR AREA 001 (INDUSTRIAL WASTE LAKE, SI-1)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No.: / Field No.:	Lake* Inlet 4947A 9001	Lake* Inlet 4975 9002	Drng Channel 4976 9003	Channel Green 2 4977 9004	Lake Bottom 6428 9007	Method Detection Limit (mg/kg)
Oil and grease		12,000	12,000	2,700	230	ND	100
Total xylenes**		31,000	30,000	ND	ND	ND	0.50
1,1,1 Trichloroethane**		1,400	3,000	ND	ND	ND	0.25
Tetrachloroethene**		2,700	13,000	ND	ND	ND	0.25
Trichloroethene**		1,400	640	ND	ND	ND	0.25
Bis(2-ethyl hexyl)phthalate		4.7	1.4	5.3	ND	ND	1
Naphthalene		7.1	2.5	ND	ND	ND	1
Phenanthrene		2.4	ND	ND	ND	ND	1
Flouranthrene		5.2	ND	ND	ND	ND	1
Benzo(b)flouranthrene		1.4	ND	ND	ND	ND	1
Benzo(a)anthracene		1.8	ND	ND	ND	ND	1
Pyrene		3.2	ND	ND	ND	ND	1
Chrysene		2.1	ND	ND	ND	ND	1

*QA/QC duplicate samples
**Concentration in ug/kg
ND - Not detected above method detection limits

Table 4-5

SUMMARY OF WATER SAMPLE ANALYSES FOR AREA 001 (INDUSTRIAL WASTE LAKE, SI-1)

(all units in ug/L)

Parameter	Type: Location: Date: Lab No.: Field No.:	Surface** Water Lake 6/26/86 4982 9005	Surface** Water Lake 6/26/86 4983 9006	Surface** Water Lake 9/26/86 8364 9008	Surface** Water Lake 9/26/86 8365 9009	Ground-water Well W1 8/20/86 7348 9010	Ground-water Well W1 9/25/86 8329 9011	Method Detection Limit (ug/L)	EPA[1] MCL	EPA[2] RMCL
Toluene		ND	ND	ND	ND	3.9	ND	0.2	(200)	(2,000)
1,1,1-Trichloroethane		0.89	0.57	7.1	3.9	ND	1.9	0.03	--	200
1,1-Dichloroethane		ND	ND	ND	ND	ND	0.18	0.07	--	--
Methylene chloride		32	25	110	98	ND	2.6	0.25	--	--
Tetrachloroethene		15	8.1	2.6	1.7	ND	ND	0.03	--	--
Trichloroethene		0.59	0.51	ND	ND	0.27	0.22	0.12	(5)	0
Butyl benzyl phthalate		ND	ND	ND	ND	11	ND	10	--	--
Bis(2-ethyl hexyl)phthalate		ND	ND	ND	ND	57	25	10	0.01[4]	--
Di-n-butyl phthalate		ND	ND	13	15	ND	26	10	0.005[4]	--
Malathion		ND	ND	ND	0.3	ND	ND	0.30	--	--
Phenols		4.8[3]	ND	ND	ND	ND	ND	0.14	--	--
Oil and grease*		2.4	3.5	1.2	1.3	0.4	0.5	0.2*	--	--
TDS*		130	150	190	110	740	270		--	--
Lead*		0.010	ND	ND	ND	0.006	0.007	0.005*	50	(20)
Zinc*		0.015	ND	ND	ND	0.25	ND	0.01*	2,000	--

ND - Not detected above method detection limit.
-- No standard given.
*Concentration in mg/L.
**QA/QC duplicate samples.
[1]Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[2]Recommended Maximum Contaminant Limits (proposed levels shown in parentheses).
[3]Value from lab sample number 5911 which was a resample for phenols only.
[4]Recommended Water Quality Criteria.

were detected in two of the five samples. The maximum concentrations of 1,1,1-trichloroethane, tetrachloroethene, trichloroethene, and total xylenes were 1,400 mg/kg, 13,000 mg/kg, 1,400 mg/kg, and 31,000 mg/kg, respectively. The PNA bis(2-ethyl hexyl)phthalate was detected in three of the five samples. The maximum concentration was 5.3 mg/kg. The PNA naphthalene was detected in two of the five samples. The maximum concentration of naphthalene was 7.1 mg/kg. The PNAs phenanthrene, flouranthrene, benzo(b)flouranthrene, benzo(a)anthracane, chrysene, and pyrene were detected in one sample.

The results from sediment samples 9001 and 9002 (the duplicate sample for 9001) may be anomalous. Sample 9002 exhibited a matrix effect during the base/neutral extraction. Repeated re-extraction failed to eliminate this effect. The variance of the analysis values for these two samples may be caused by the nonhomogeneity of the sample matrix.

Two surface water samples and two duplicates were collected and analyzed. The purgeable organics, 1,1,1-trichloroethane, methylene chloride, and tetrachloroethene were detected in all four samples. The 1,1,1-trichloroethane concentration range was 0.57 ug/L to 7.1 ug/L. The methylene chloride concentration range was 25 ug/L to 110 ug/L. The tetrachloroethene concentration range was 1.7 ug/L to 15 ug/L. Trichloroethene was detected in two of the four samples. The maximum trichloroethene concentration was 0.59 ug/L. All four of the samples had an elevated concentration of oil and grease. The oil and grease concentration range of these four samples was 1.2 mg/L to 3.5 mg/L. Duplicate samples of surface water were collected during each round of sampling. Agreement between duplicate analyses was good.

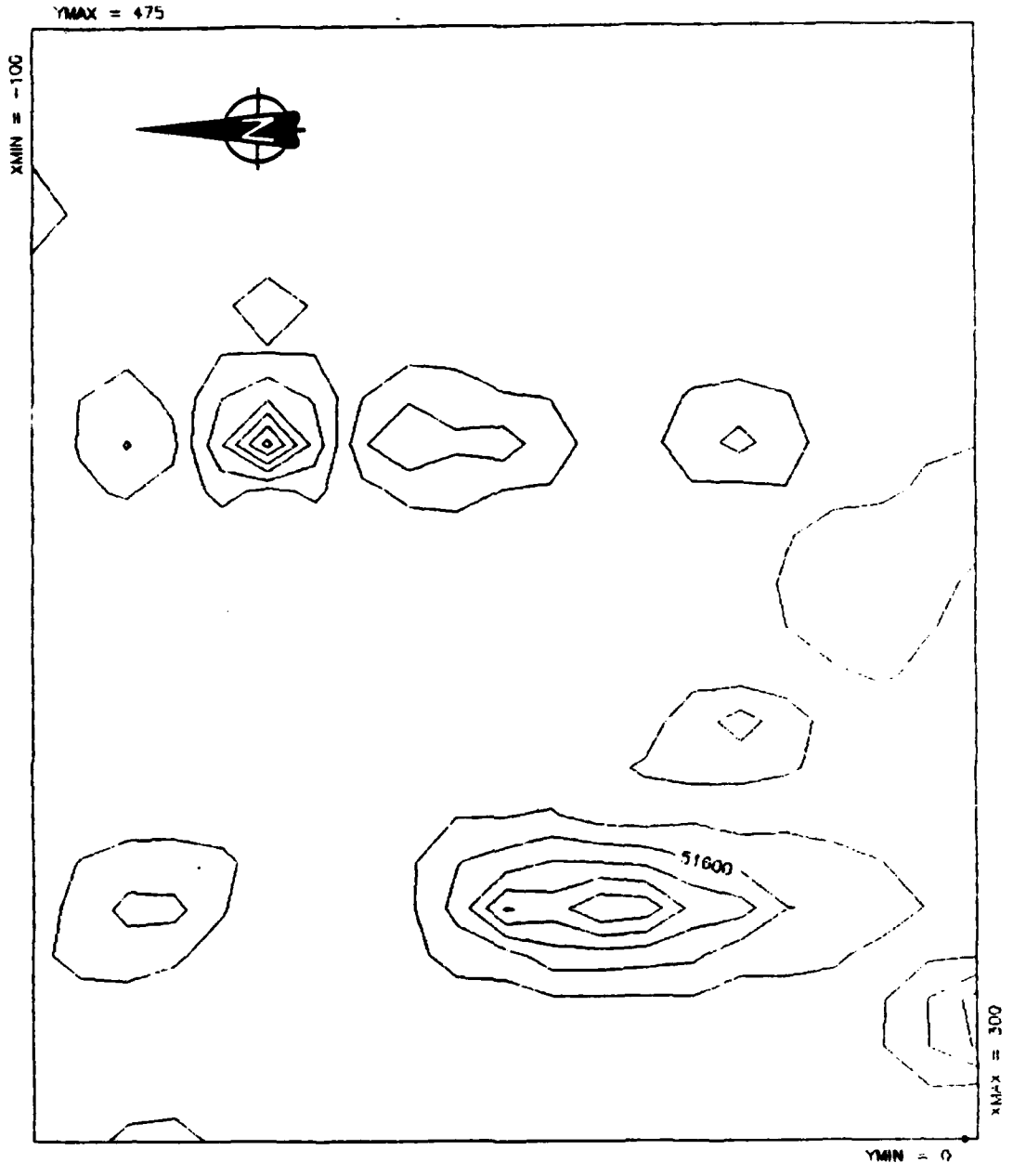
Two groundwater samples were collected and analyzed. Trichloroethene, bis(2-ethyl hexyl)phthalate, lead, and oil and grease were detected in both samples. The maximum concentrations of trichloroethene, bis (2-ethyl hexyl)phthalate, lead, and oil and grease were 0.27 ug/L, 57 ug/L, 0.007 mg/L, and 0.5 mg/L, respectively. Toluene, butyl benzyl phthalate, and zinc were detected in sample 9010 only. Methylene chloride, 1,1,1-trichloroethane, 1-1-dichloroethane, and di-n-butyl phthalate were found in sample 9011 only.

4.1.2 Area 002: Sewage Lake (Including Landfills D-3, D-4, and D-5, and Inactive Fire Training Area FT-3)

Fieldwork Results

Geophysical surveys were conducted on Landfills D-3 and D-4 to assist in defining the landfill perimeter and the location of borings. Both magnetometer and EM surveys were performed. Data derived from these surveys are presented in Appendix H. Figure 4-2 (back pocket) shows the location of the geophysical survey for each site investigated as part of the IRP. Upon completion of the surveys, data were interpreted and borings located; borings were to be located between the landfills and the lake. Geophysical data were plotted and contoured for presentation using Golden Graphics System designated for the IBM Personal Computer (Golden Software, 1984). Review of a 1950 aerial photograph showed the existence of a north-south trending in the area of D-3. The geophysical survey was designed to investigate the approximate area of the trench and adjacent area. Figures 4-3 and 4-4 show the plots of the magnetometer and EM data respectively. (For all magnetometer and EM maps, see Figure 4-2, back pocket, for survey plot location.) The magnetometer data shows two areas of magnetic anomalies with north-south orientations. These areas are present but not as clearly defined in the EM data. The EM data shows a broader distribution of the area than the magnetometer data. Based upon these data, the well at Area 002 was located between the lake and the southern limit of Landfill D-3.

Aerial photographs from 1950 through 1955 showed the areas of D-4, D-5, and FT-3 at one time overlapped. To adequately locate the perimeter of D-4, magnetometer and EM surveys were conducted. Figures 4-5 and 4-6 show the magnetometer and EM data, respectively. The magnetometer data shows three areas of high ferromagnetic interference suggesting buried materials. The areas along the eastern perimeter of the survey are the result of surface materials stored at the Civil Engineering storage area. The EM data is more scattered but essentially corresponds to the areas of anomaly in the magnetometer data. Based upon the geophysical survey, the northernmost area of the survey appears essentially clean. The borings were located based upon the surveys between the landfill and the lake.



D3 MAG

APPROXIMATE SCALE: 1" = 42 FEET
SURVEY DATE: 27 JUNE 1986

Figure 4–3 AREA 002 (EAST LANDFILL D-3): MAGNETOMETER SURVEY PLOT

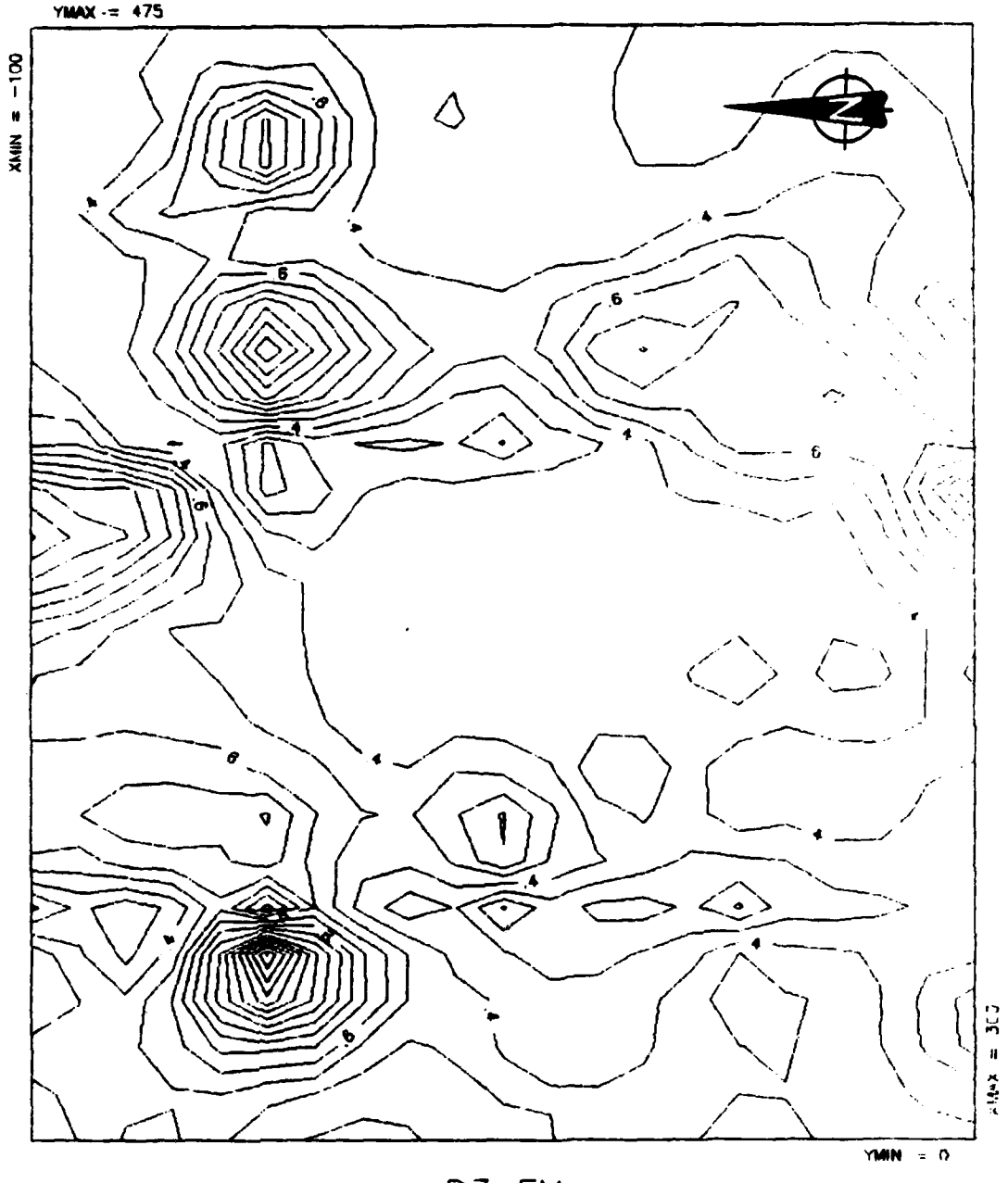
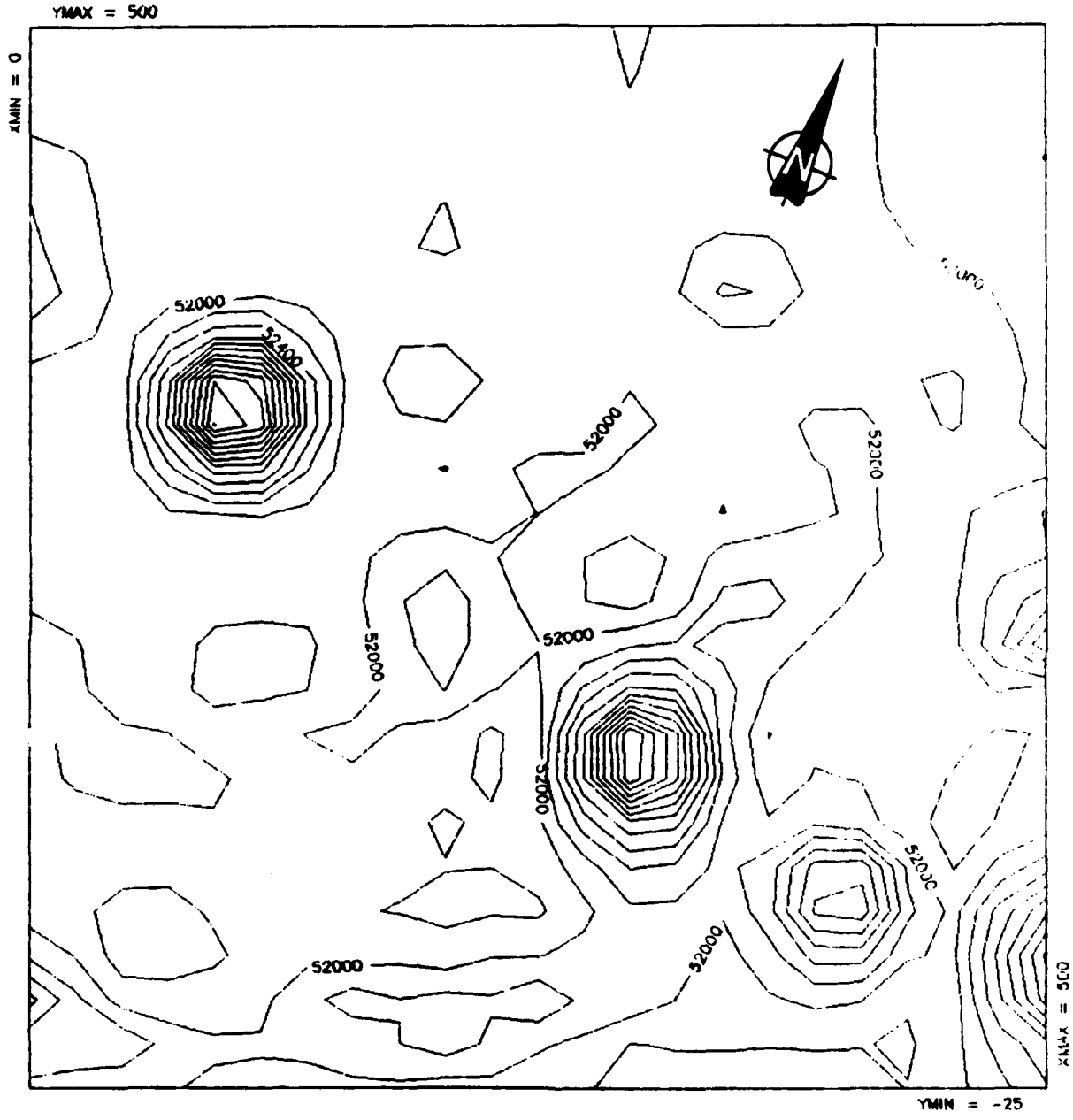


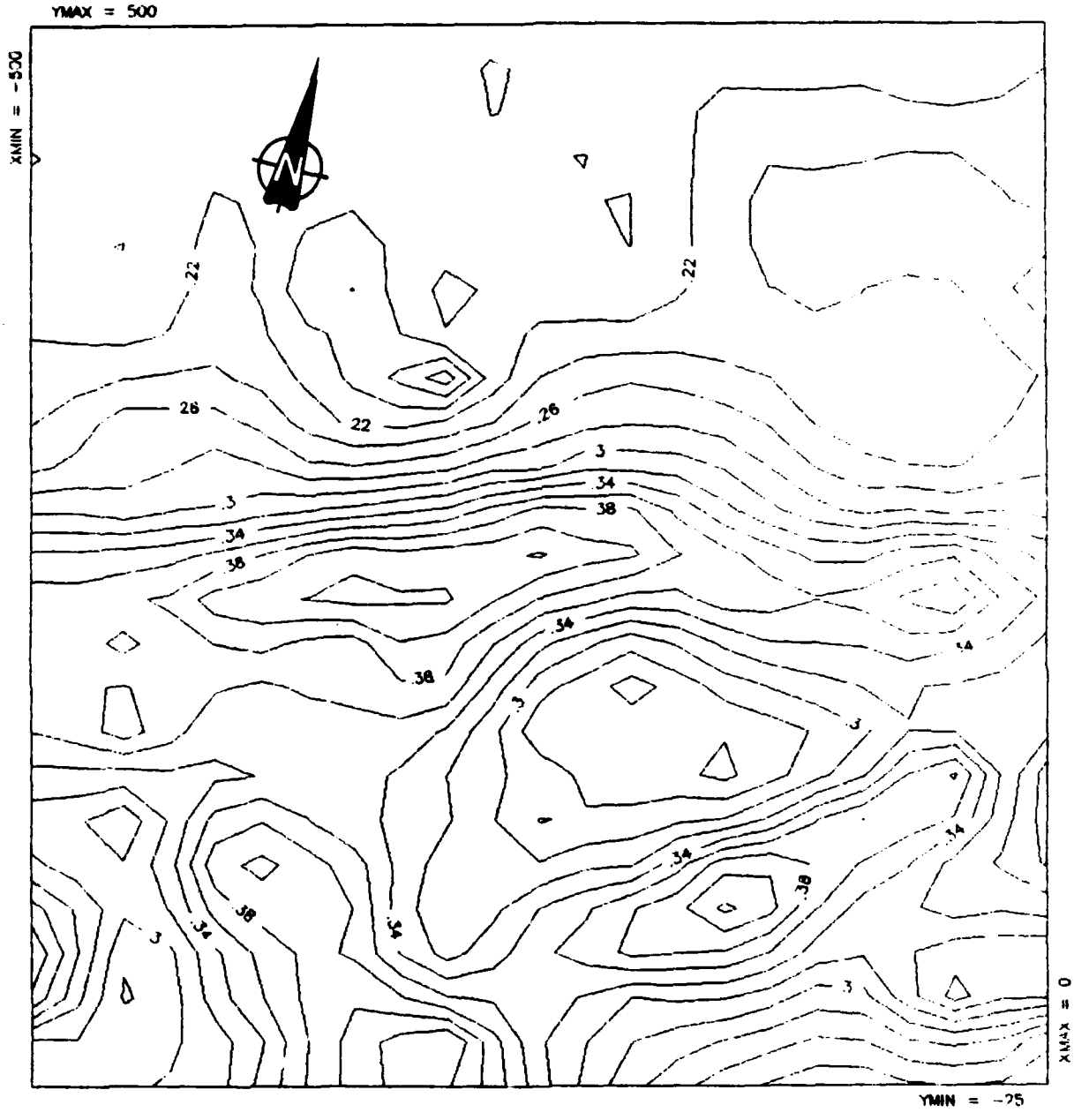
Figure 4–4 AREA 002 (EAST LANDFILL D-3): EM SURVEY PLOT



D4 MAG STUDY

APPROXIMATE SCALE. 1" = 71 FEET
SURVEY DATE: 30 JUNE 1986

Figure 4–5 AREA 002 (NORTH LANDFILL D-4): MAGNETOMETER SURVEY PLOT



D4 EM STUDY

APPROXIMATE SCALE: 1" = 71 FEET
SURVEY DATE: 30 JUNE 1986

Figure 4–6 AREA 002 (NORTH LANDFILL D-4): EM SURVEY PLOT

The determination of the subsurface geology was based upon the soils collected during the drilling of the three boreholes and the one monitoring well. Subsurface materials consist mainly of tight dry silts to a depth of about 20 feet. Boring 1, caliche was encountered at 20.4 feet. In Boring 2 and 3, sandy silts were encountered at 20.5 feet. These silty sands were tight and dry and precluded further drilling with the auger. W-1 encountered some gravels intermixed with the silts from 20 feet to the top of the caliche, which was at 38 feet. Below the caliche, based upon materials encountered in W-1, are interbedded silts, clays and sands. No water was encountered in B-1, B-2, or B-3. Water was encountered in W-1 at a depth of about 100 feet. Details of the materials encountered are presented in Appendix D.

The groundwater level was determined from monitoring well W1. Water levels were measured, below the top of the PVC casing, as 97.67 feet on August 20, 1986, and 95.0 feet on September 25, 1986. The well showed good recharge and capacity during development and purging. During purging the well was pumped at 12 gallons per minute.

Analytical Results

A summary of analytical results for Area 002 is presented in Tables 4-4, 4-5, and 4-6. Table 4-4 compares the compounds detected above the method detection limits for the soil samples to their respective sample locations. Table 4-5 compares the compounds detected above the method detection limits for the sediment samples to their respective sample locations. Table 4-6 compares the compounds detected above the method detection limits for the water samples to their respective sample locations.

Methylene chloride, a typical laboratory contaminant, was detected in the blank sample for purgeable organics. The concentration of methylene chloride reported in the samples have been adjusted to reflect the blank contamination levels.

Oil and grease was present in three of the ten samples. The concentration range of oil and grease from the soil samples was ND to 200 mg/kg.

Sediments collected from the low flow area at the Polishing Lake Discharge showed the presence of DDD and DDT at 3.1 and 2.4 mg/kg,

Table 4-4

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 002 (SEWAGE LAKE, SI-2)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No. / Field No.	B1 5-6.5' 6004 9033	B1 15-16.5' 6005 9034	B1 20-21 6006 9035	B2 1-2.5' 6007 9036	B2 15-16.5' 6008 9037	B2 19-20.5' 6009 9038	B3 1-2.5' 6010 9039	B3 15-16.5' 6011 9040	W1 3' 7022 9042	W1 15' 7023 9043	Method Detection Limit (mg/kg)
Oil and grease		200	ND	160	ND	ND	ND	ND	ND	ND	200	100

ND - Not detected above method detection limit

Table 4-5

SUMMARY OF SEDIMENT SAMPLE ANALYSES FOR AREA 002 (SEWAGE LAKE, SI-2)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No.: / Field No.:	Sewage Plant Discharge 4978 9025	Low Flow Discharge Area 4979 9026	Lake Bottom 0-1' 6827 9027	Lake Bottom 0-1' 6828 9028	Threshold Concentrations*	Method Detection Limit (mg/kg)
Oil and grease		ND	1,100	ND	ND	--	100
4-4' DDD		ND	3.1	NA	NA	--	1.0
4-4' DDT		ND	2.4	NA	NA	--	1.0
Chromium		NA	NA	22	22	31.5	5
Lead		NA	NA	11	11	46	10

NA - Sample not analyzed for parameter
ND - Not detected above method detection limit
*The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).

Table 4-6

SUMMARY OF WATER SAMPLE ANALYSIS FOR AREA 002 (SEWAGE LAKE, SI-2)

(all units in ug/L)

Parameter	Type: / Date: / Lab No.: / Field No:	Surface Water Polishing Lake Discharge 8/7/86 6426 9029	Surface Water Pump Inlet N.E. Corner 8/7/86 6427 9030	Surface Water Polishing Lake Discharge 9/26/86 8366 9044	Surface Water Pump Inlet N.E. Corner 9/26/86 8367 9045	Groundwater Well 002-W1 8/20/86 7349 9031	Groundwater Well 002-W1 9/25/86 8330 9032	Method Detection Limit (ug/L)	EPA MCL[1]	EPA RMCL[2]
Toluene		1.5	ND	ND	ND	6.8	0.47	0.2	(200)	(2,000)
1,4-Dichlorobenzene		ND	1.1	ND	ND	ND	ND	0.3	(750)	750
1,1-Dichloroethane		ND	ND	ND	ND	ND	0.15	0.07	--	--
1,1,1-Trichloroethane		ND	ND	ND	1.6	ND	ND	0.03	--	--
Bis(2 ethyl hexyl) phthalate		ND	ND	ND	ND	160	93	10	0.01[3]	--
Di-n-butyl phthalate		ND	ND	14	13	ND	36	10	0.005[3]	--
Chlorpyrifos		ND	ND	0.46	0.38	ND	ND	0.30	--	--
Malathion		ND	ND	ND	0.43	ND	ND	0.30	--	--
Oil and grease*		2.1	1.3	1.7	1.4	0.8	0.6	0.2*	--	--
TDS*		300	360	310	180	660	700	--	--	--
Lead*		0.007	ND	0.007	ND	0.007	ND	.005*	50	(20)
Zinc*		ND	ND	0.061	ND	0.071	ND	.05*	2,000	--

ND - Not detected above method detection limit
-- - No standard given
*Concentration in mg/L
[1]Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses)
[2]Recommended Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses)
[3]Recommended Water Quality Criteria

respectively. Oil and grease was determined at a concentration of 1,100 mg/kg from this same sample.

Chlorpyrifos and malathion were detected but below quantification level in the lakewater samples collected at the pump discharge area and the Polishing Lake Discharge. A toluene concentration of 1.5 ug/L was detected at the Polishing Lake Discharge. A 1,4-dichlorobenzene concentration of 1.1 ug/L was detected at the Pump Inlet.

Toluene was found in the groundwater samples from each of the two sampling efforts. Concentrations of 6.8 ug/L and 0.47 ug/L were reported. Phthalates were also detected in each of the groundwater samples. Bis(2-ethyl hexyl)phthalate and di-n-butyl phthalate were detected in the groundwater.

Oil and grease was detected in both the surface water and the groundwater samples. The oil and grease concentration range for surface water samples was 1.3 mg/L to 2.1 mg/L. The oil and grease concentration range for groundwater samples was 0.6 mg/L to 0.8 mg/L.

Inorganic compounds were reported for sediment samples, but at levels not exceeding the threshold concentration.

4.1.3 Area 003: POL Storage Area

Fieldwork Results

The soil gas survey conducted to check for soil contamination by volatile compounds failed to show the presence of any volatile compounds. No readings were detected on the OVA in any of the 24 sampling points. Volatile compounds were detected by the OVA in the ambient air during the soil gas survey. The probable causes for these readings were the presence of a fuel truck which was leaking fuel within the POL area and the presence of jet exhaust from the jet engine test cell area.

Four borings were drilled at Area 003 (see Figure 4-1, back pocket) to define subsurface characteristics and to check for vertical migration of potential contamination. Borings penetrated from 19.0 feet to a maximum of 28.5 feet. No water was encountered in any of the borings.

Analytical Results

A summary of analytical results for Area 003 is presented in Table 4-7. Table 4-7 compares the compounds detected above method detection limits for the soil samples to their respective sample locations.

Soil samples collected from boreholes B1, B2, B3, and B4 showed the presence of chromium and lead. All soil samples had concentrations of chromium above method detection limits. Eight of the 17 soil samples had lead concentrations above method detection limits. No vertical concentration distribution trend for either chromium or lead was determined based on the data.

Oil and grease was detected in three of the 17 soil samples collected. Samples from boreholes B2, B3, and B4 showed the presence of oil and grease. The positive samples all came from different depths. The maximum concentration of oil and grease (230 mg/kg) came from a soil sample from borehole B3.

Two soil samples, both collected from borehole B1, showed the presence of petroleum hydrocarbons. The maximum petroleum hydrocarbon concentration was 110 mg/kg.

4.1.4 Area 004: Southwest Landfill D-1

Fieldwork Results

Magnetometer and EM surveys were conducted across Area 004 to define the perimeter of the landfill so that the borings could be located adjacent to, but not within, the landfill and to attempt to define the location of the trenches known to be present in the landfill. Figure 4-2 (back pocket) shows the areas of geophysical investigation. Figures 4-7 and 4-8 show the magnetometer and EM data plots. Both plots show the triangular shape of the landfill area. Neither plot, however, defines the location or configuration of the disposal trenches.

The plot of the magnetometer data shows that the area of buried ferromagnetic materials is essentially confined to the southern end of the landfill with the exception of a small area to the north. The EM data corraborate this and show a conductive zone potentially to the southwest of the landfill proper.

Table 4-7

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 003 (POL STORAGE AREA SPILL SITE, SP-1)

(all units in mg/kg dry weight)

Parameter	Location:	B2 5-6.5'	B2 10-11.5'	B2 15-16.5'	B2 20-21.5'	B3 5-6.5'	B3 10-11.5'	B3 15-16.5'	B3 17.5-19'	B4 5-6.5'	B4 10-11.5'	B4 15-16.5'
	Lab No.:	6159	6160	6161	6162	6163	6164	6165	6166	6167	6168	6169
	Field No.:	9061	9062	9063	9064	9065	9066	9067	9068	9069	9070	9071
Oil and grease		ND	ND	140	ND	ND	230	ND	ND	120	ND	ND
Petroleum hydrocarbons		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium		6.7	12	12	8.3	8.6	9.4	9.0	7.8	17	11	10
Lead		ND	6.2	ND	ND	ND	8.3	ND	ND	6.3	5.3	5.4

ND - Not detected above method detection limits

Table 4-7 (Cont.)

Parameter	Location: / Lab No.: / Field No.:	B2* 27-28.5' 6170 9143	B2* 27-28.5' 6171 9150	B1 5-6.5' 6227 9057	B1 10-11.5' 6228 9058	B1 15-16.5' 6229 9059	B1 17-19.5' 6230 9060	Threshold Concentration**	Method Detection Limit (mg/kg)
Oil and grease		ND	ND	ND	ND	ND	ND	--	100
Petroleum hydrocarbons		ND	ND	53	ND	110	ND	--	10
Chromium		6.5	5.9	9.3	5.9	10	7.7	31.5	5
Lead		ND	ND	6.9	ND	6.1	5.0	46	5

ND - Not detected above method detection limits
*QA/QC duplicate samples
**The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).

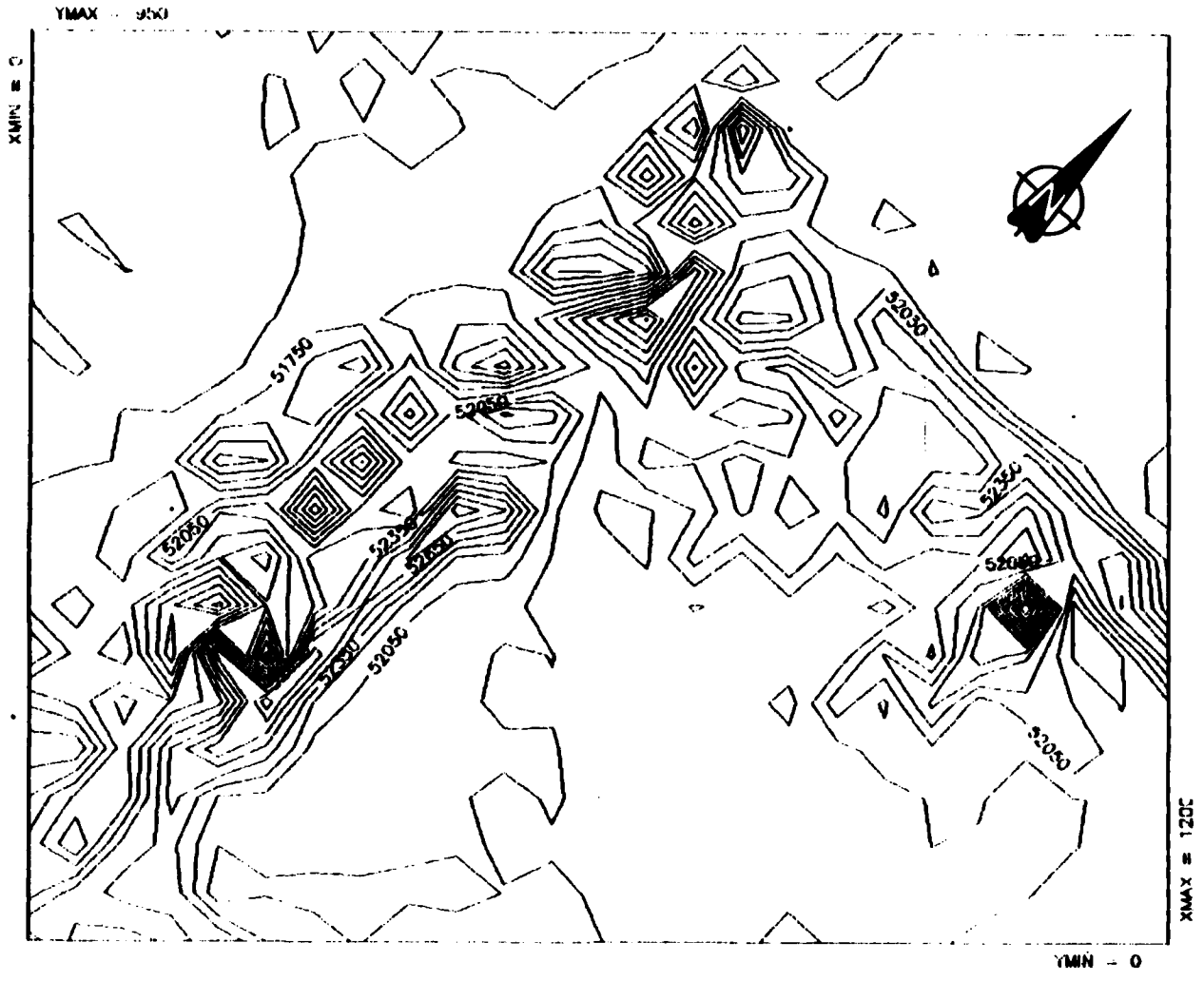
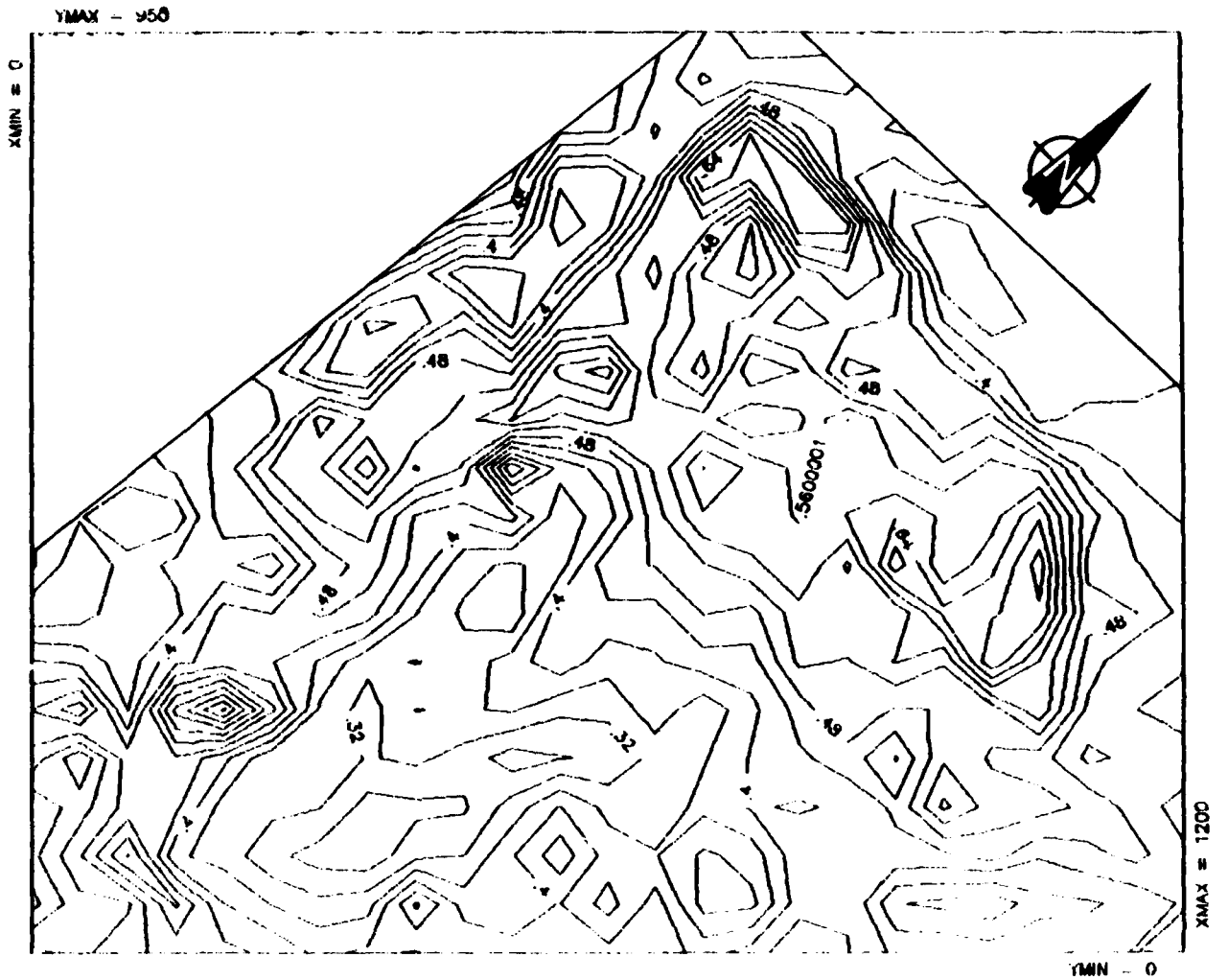


Figure 4–7 AREA 004 (SOUTHWEST LANDFILL D-1): MAGNETOMETER SURVEY PLOT



D1 EM STUDY

APPROXIMATE SCALE: 1" = 218 FEET
SURVEY DATE: 30 JUNE 1986

Figure 4–8 AREA 004 (SOUTHWEST LANDFILL D-1): EM SURVEY PLOT

Based upon the geophysical data, the borings were located as close as possible to the landfill itself. The monitoring well was located in the the southwestern corner of the landfill adjacent to the area of magnetic and conductivity anomaly. Figure 4-1 (back pocket) shows the location of the borings and the monitoring well.

The determination of the subsurface geology was based upon the soils collected during the drilling of the three boreholes and the one monitoring well. The subsurface materials are dry tight silts to a depth of about 30 feet. Caliche was encountered at about 30 feet. No water was encountered above the caliche. Based on the deep boring, the materials beneath the caliche are interbedded silts, clays, and sands. Details of the materials encountered are presented in Appendix D.

The groundwater level was determined from monitoring well W1. Water levels in the well, as measured below the top of the PVC casing, were 129.19 feet on August 20, 1986 and 128.9 feet on September 25, 1986.

Analytical Results

A summary of analytical results for Area 004 is presented in Tables 4-8 and 4-9. Table 4-8 compares the compounds detected above method detection limits for the soil samples to their respective sample locations. Table 4-9 compares the compounds detected above method detection limits for the water samples to their respective sample locations.

All of the soil samples were found to contain zinc, but none of the concentrations was in excess of the threshold value. Chromium concentrations ranged from ND to a maximum of 14 mg/kg. Copper was found in 10 of the borings at concentrations of 2.4 to 8.5 mg/kg. Lead was found in 4 of the borings at concentrations above the method detection limit. Nickel was found in 1 boring at a concentration of 13 mg/kg. No organic compounds were detected in the soil samples.

Groundwater analysis showed the presence of organic solvents and phthalates in each of the monitoring well samples. Toluene and trichloroethene were detected in both samples. Second round sample confirmed the presence of contamination. Toluene concentrations were 3.2 ug/L and 0.88 ug/L, below the current proposed RMCL. Trichloroethene

Table 4-8

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 004 (SOUTHWEST LANDFILL, D-1)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No.: / Field No.:	B1 1-2.5' 6043 9075	B1 15-16.5' 6044 9076	B1 30-31.5' 6045 9077	B2 5-6.5' 6046 9078	B2 15-16.5' 6053 9079	B2 19.5-21' 6054 9080	B3 5-6.5' 6047 9081	B3 15-16.5' 6048 9082	B3* 30-31.5' 6049 9083	B3* 30-31.5' 6050 9142
Chromium		14	8.6	8.1	14	7.6	6.5	9.5	6.2	ND	ND
Copper		7.6	4.5	3.1	8.5	6	3.5	5.2	4.9	ND	ND
Lead		7	ND	5.7	8.3	ND	ND	ND	ND	ND	ND
Nickel		ND	ND	ND	13	ND	ND	ND	ND	ND	ND
Zinc		32	20	16	36	19	15	24	22	11	9.2
Oil & Grease		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4-8 (Cont.)

Parameter	Location: / Lab No.: / Field No.:	W1 3' 6231 9084	W1 15' 6232 9085	W1 30' 6233 9086	Threshold Concentration**	Method Detection Limit (mg/kg)
Chromium		5.8	10	ND	31.5	5
Copper		4.2	6.9	2.4	11.2	2
Lead		ND	5.7	ND	46.0	5
Nickel		ND	ND	ND	--	10
Zinc		14	26	8.8	50.7	4
Oil & Grease		160	ND	ND	--	--

ND - Not detected above method detection limits.
*QA/QC duplicate samples.
**The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).

Table 4-9

SUMMARY OF WATER SAMPLE ANALYSES FOR AREA 004 (SOUTHWEST LANDFILL, D-1)

(all units in ug/L unless noted otherwise)

Parameter	Type:	Ground Water	Ground Water	EPA[1] MCL	EPA[2] RMCL	Method Detection Limit (ug/L)
	Location:	Well W1	Well W1			
	Date:	8/20/86	9/25/86			
	Lab No:	7350	8331			
	Field No:	9073	9074			
Toluene		3.2	0.88	(200)	(2,000)	0.2
Trichloroethene		41	24	(5)	0	0.12
Diethylphthalate		11	ND	0.06[3]	--	10
Di-n-butyl phthalate		ND	17	0.005[3]	--	10
Bis(2-ethylhexyl)phthalate		80	ND	0.013	--	10
Oil and grease*		2.3	1.6	--	--	0.2*
TDS*		900	1,300	--	--	--
Copper*		0.022	ND	1,000	(1,300)	20
Lead*		0.012	0.008	50	(20)	5
Zinc*		0.37	0.55	2,000	--	50

ND - Not detected above method detection limits
-- No standard or advisory given
*Concentration in mg/L

[1]MCL - Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[2]RMCL - Recommended Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[3]Recommended Water Quality Criteria.

concentrations were 41 ug/L and 24 ug/L, which is above the current proposed RMCL. Diethylphthalate, di-n-butylphthalate, and bis (2-ethyl hexyl)phthalate were detected in the groundwater samples. A bis(2-ethylhexyl)phthalate concentration of 80 ug/L was detected in a groundwater sample from the first round of sampling. It was not detected above method detection limits during the second round of sampling. None of the phthalate levels was above the EPA Recommended Water Quality Criteria.

Inorganics reported for the groundwater samples were below the existing drinking water standards or EPA criteria.

4.1.5 Area 005: Civil Engineering Paint Trench

Fieldwork Results

The determination of the subsurface geology was based upon the soils collected during the drilling of the monitoring well. The subsurface materials consist of a mix of dry silts, clays, and caliche fragments to a depth of 33 feet. At 33 feet the caliche was intercepted. Below the caliche to the total depth of the well, the materials were interbedded silts, clays, and sands. The water table in the area was at 116 feet below the top of the well casing. Details of the materials encountered are presented in Appendix D.

Analytical Results

A summary of analytical results for Area 005 is presented in Tables 4-10 and 4-11. Table 4-10 compares the compounds detected above method detection limits for the soil samples to their respective sample locations. Table 4-11 compares the compounds detected above method detection limits for the water samples to their respective sample locations.

Organic and inorganic analysis for the subsurface soils reported no organic compounds above detection limits. Chromium was detected in one of the three samples at a concentration of 10 mg/kg. Lead was found in one of the three samples at a concentration of 7.2 mg/kg. Zinc was found in all three samples. The zinc concentration range was 10 mg/kg to 21 mg/kg.

Table 4-10

SUMMARY OF SOIL SAMPLES ANALYSES FOR AREA 005
(CIVIL ENGINEERING PAINT SHOP TRENCH, SI-4)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No.: / Field No.:	Well W1 3' 6055 9090	Well W1 15' 6056 9091	Well W1 30' 6057 9092	Threshold Concentration*	Method Detection Limit (mg/kg)
Chromium		ND	10	ND	31.5	5
Lead		ND	7.2	ND	46.0	5
Zinc		12	21	10	50.7	4

ND - Not detected above method detection limits
*The concentration above which a sample's concentration can be considered contaminant (see Section 4.1).

Table 4-11

SUMMARY OF WATER SAMPLE ANALYSES FOR AREA 005
(CIVIL ENGINEERING PAINT SHOP TRENCH, SI-4)

(all units in ug/L unless noted otherwise)

	Type:	Groundwater	Groundwater	Groundwater			
	Location:	Well W1**	Well W1**	Well W1			
	Date:	8/17/86	8/17/86	9/26/86			
	Lab No:	7297	(7325) 7298	(8385)*** 8369	Method Detection Limit (ug/L)	EPA MCL[1]	EPA RMCL[2]
Parameter	Field No.:	9088	9089	9140			
Toluene		1.7	2.2	1.2	0.2	200	(2,000)
Methylene chloride		4	6.6	ND	0.25	--	--
Di-n-butyl-phthalate		10	24	13	10	0.005[3]	--
Oil and grease*		1.3	2.9	3.4	0.2	--	--
TDS*		NR	NR	920	--	--	--
Copper*		ND	0.023	ND	20	1,000	(1,300)
Lead*		0.014	0.019	0.03	5	50	(20)
Zinc*		0.20	0.21	0.36	50	2,000	--

-- No standard or advisory given.
ND - Not detected above method detection limit.
NR - Not requested.
*Concentrations in mg/L.
**QA/QC duplicate samples.
***Resample for TDS.
[1]MCL - Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses.
[2]RMCL - Recommended Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[3]Recommended Water Quality Criteria.

Groundwater analysis for the duplicate samples from the first round of sampling (samples 9088 and 9089) showed two organic solvents and one phthalate. Toluene was reported at 1.7 ug/L and 2.2 ug/L, respectively. Both toluene values were substantially below EPA MCLs or RMCLs. Methylene chloride concentrations from first round samples 9088 and 9089 were 4 mg/L and 6.6 mg/L, respectively. The values for methylene chloride may be considered laboratory contaminants. No EPA standards exist for this compound. Di-n-butyl phthalate was reported at 10 and 24 ug/L. Toluene (1.2 ug/L) and di-n-butyl phthalate (13 ug/L) were also found in the second round sample (Sample 9140). Oil and grease was detected in groundwater samples from both rounds of sampling. The oil and grease concentration range of the groundwater samples was 1.3 mg/L to 3.4 mg/L.

4.1.6 Area 006: Active Fire Training Area (FT-1) Including the Drainage Impoundment (SI-3)

Fieldwork Results

Based upon two borings drilled at Area 006 (see Figure 4-1), subsurface materials are tight, dry silt to a depth of at least 23 to 26 feet. No water was found in either boring. Details of materials encountered are shown in Appendix D.

Analytical Results

A summary of the analytical results for Area 006 is presented in Tables 4-12 and 4-13. Table 4-12 compares the compounds detected above method detection limits for the soil samples to their respective sample locations. Table 4-13 compares the compounds detected above method detection limits for the sediment samples to their respective sample locations.

Lead was detected in four of the eight samples collected from the two borings at this site. Lead levels for the four samples ranged from 5.6 to 7.2 mg/kg. Chromium was found in six out of the eight samples. A wide range of concentrations was reported (8.1 to 72 mg/kg) with two samples (9051 and 9052) reporting levels in excess of the threshold value. Oil and grease was found above the detection limit in three of the samples at a range of 160 to 190 mg/kg.

Table 4-12

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 006
(ACTIVE FIRE TRAINING AREA, FT-1)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No: / Field No:	B1 5-6.5' 6829 9049	B1* 13-16' 6830 9050	B1 20-21.5' 6831 9051	B1 25-26.5' 6832 9052	B2 5-6.5' 6833 9053	B2 15-16.5' 6834 9054	B2 20-21.5' 6835 9055	B1* 13-16' 6836 9144	Threshold Concentration**	Method Detection Limit (mg/kg)
Oil and grease		ND	160	ND	ND	190	180	ND	ND	--	100
Chromium		11	8.1	48	72	11	ND	ND	8.9	31.5	5
Lead		7	5.7	ND	ND	7.2	ND	ND	5.6	46.0	5

ND - Not detected above method detection limit
*QA/QC duplicate samples
**The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).

Table 4-13

SUMMARY OF SEDIMENT SAMPLE ANALYSES FOR AREA 006
(DRAINAGE IMPOUNDMENT, SI-3)

(all units in mg/kg dry weight)

Parameter	Location: Lab No.: Field No.:	Sump Outlet 4980 9047	Natural Depression 4981 9048	Threshold Concentration*	Method Detection Limit (mg/kg)
Oil and grease		250	ND	--	100
Chromium		18	17	31.5	5
Lead		16	13	46.0	10

ND - Not detected above method detection limits
*The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).

No organic compound in excess of detection limits was reported for any subsurface soil sample.

Lead and chromium were reported for both of the sediment samples. Sample 9047 (sump outlet) had a lead concentration of 16 mg/kg and a chromium concentration of 18 mg/kg while Sample 9048 (natural depression) had 13 mg/kg and 17 mg/kg, respectively. Oil and grease was reported for Sample 9047 at 250 mg/kg.

4.1.7 Area 007: Northwest Landfill/Rubble Area (D-11)

Fieldwork Results

An EM survey was conducted at Area 007 to attempt to ascertain the landfill perimeter (see Figure 4-2). Surface debris, mostly concrete, was observed over most of the landfill area. Attempts were made to run magnetometry but no significant variation in magnetic intensity could be defined. No good definition of the landfill perimeter was found using the EM. A plot of the EM data is found on Figure 4-9. Based on the limited EM data and the scatter of surface debris, four borings were located around the perimeter of the suspected landfill area (see Figure 4-1, back pocket).

The determination of the subsurface geology was based upon the soils collected during the drilling of the four boreholes. The subsurface materials at this site consist primarily of dry tight silts. One boring (B-1) reached refusal at 18.5 feet. Two borings (B-2 and B-3) were terminated at 31.5 feet. None of these borings intercepted the caliche. B-4 showed some gravel and sand from 20.4 to 28.0 feet, where the caliche was intercepted. No water was encountered in any of the borings. Details of the materials encountered are shown in Appendix D.

Analytical Results

A summary of the analytical results for Area 007 is presented in Table 4-14. Table 4-14 compares the compounds detected above method detection limits for the soil samples to their respective sample locations.

No inorganics were reported above method detection limits.

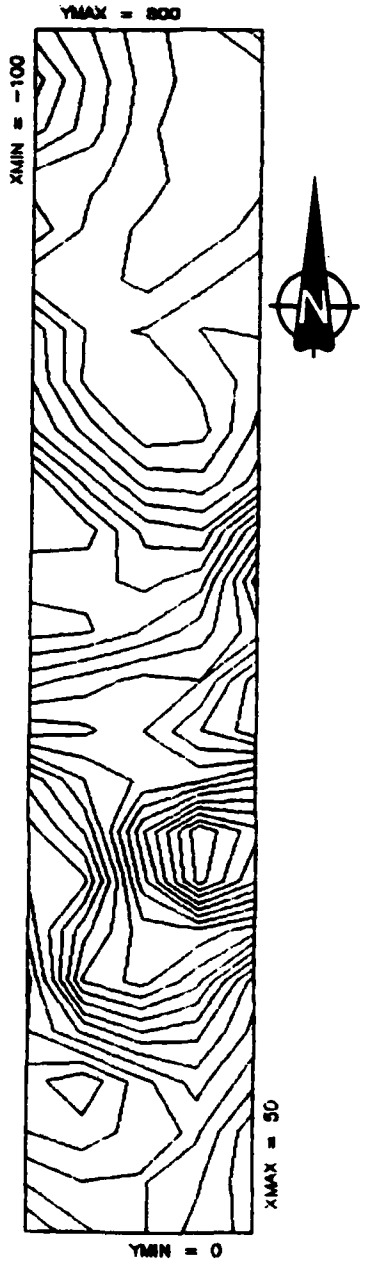


Figure 4–9 AREA 007 (NORTHWEST LANDFILL / RUBBLE AREA D-11): EM SURVEY PLOT
(See Figure 4–2, back pocket, for survey plot location)

Table 4-14

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 007
(NORTHWEST LANDFILL/RUBBLE AREA, D-11)

(all units in mg/kg dry weight)

Parameter	Location: / Lab No: / Field No:	B1 5-6.5' 6234 9093	B1 15-16.5' 6235 9094	B1 17-18.5' 6236 9095	B2 5-6.5' 6237 9096	B2 15-16.5' 6238 9097	B2 30-31.5' 6239 9098	B3 5-6.5' 6240 9099	B3 15-16.5' 6241 9100	B3 30-31.5' 6242 9101	B-4 5-6.5' 6243 9102	B-4 15-16.5' 6244 9103	B-4* 25-28.5' 6245 9104	B-4* 25-28.5' 6246 9138	Method Detection Limit (mg/kg)
Oil and grease		ND	170	ND	ND	150	ND	190	ND	ND	1,500	ND	ND	ND	100

ND - Not detected above method detection limits

*QA/QC duplicate samples

Oil and grease were the only reported organic analysis with results in excess of method detection limits. Oil and grease was reported for four of the 13 samples collected at the site. Oil and grease levels were less than 200 mg/kg in three samples. Sample 9102 had an oil and grease concentration of 1,500 mg/kg.

4.1.8 Area 008: Hurlwood Acquisition and Landfill D-7

Fieldwork Results

Review of a 1977 aerial photo showed a single north-south trending trench in the area of Area 008. Magnetometer and EM surveys were conducted here in order to define the landfill boundaries and to allow appropriate location of borings (see Figure 4-2). Figures 4-10 and 4-11 show the magnetometer and EM data plots respectively. The magnetometer data indicate magnetic anomalies oriented east-west parallel to the railroad. The EM data shows some east-west variation in conductivity in the eastern end of the survey area.

Based upon the geophysical results, two borings were located at the ends of the anomaly areas (see Figure 4-1).

The determination of the subsurface geology was based upon the soils collected during the drilling of the two boreholes. The subsurface materials consist primarily of greenish, very tight dry clays to a depth of 25.5 feet at B-1. This was the only boring of the entire investigation which encountered clays of this coloration. B-2 showed dry, tight, reddish-brown silts to a depth of 18.3 feet. No water was encountered in either boring.

Analytical Results

A summary of analytical results for Area 008 is presented in Tables 4-15 and 4-16. Table 4-15 compares the compounds detected above method detection limits for the soil samples to their respective sample locations. Table 4-16 compares the compounds detected above method detection limits for the water samples to their respective sample locations.

Soils analysis indicated no organic compounds in excess of method detection limits.

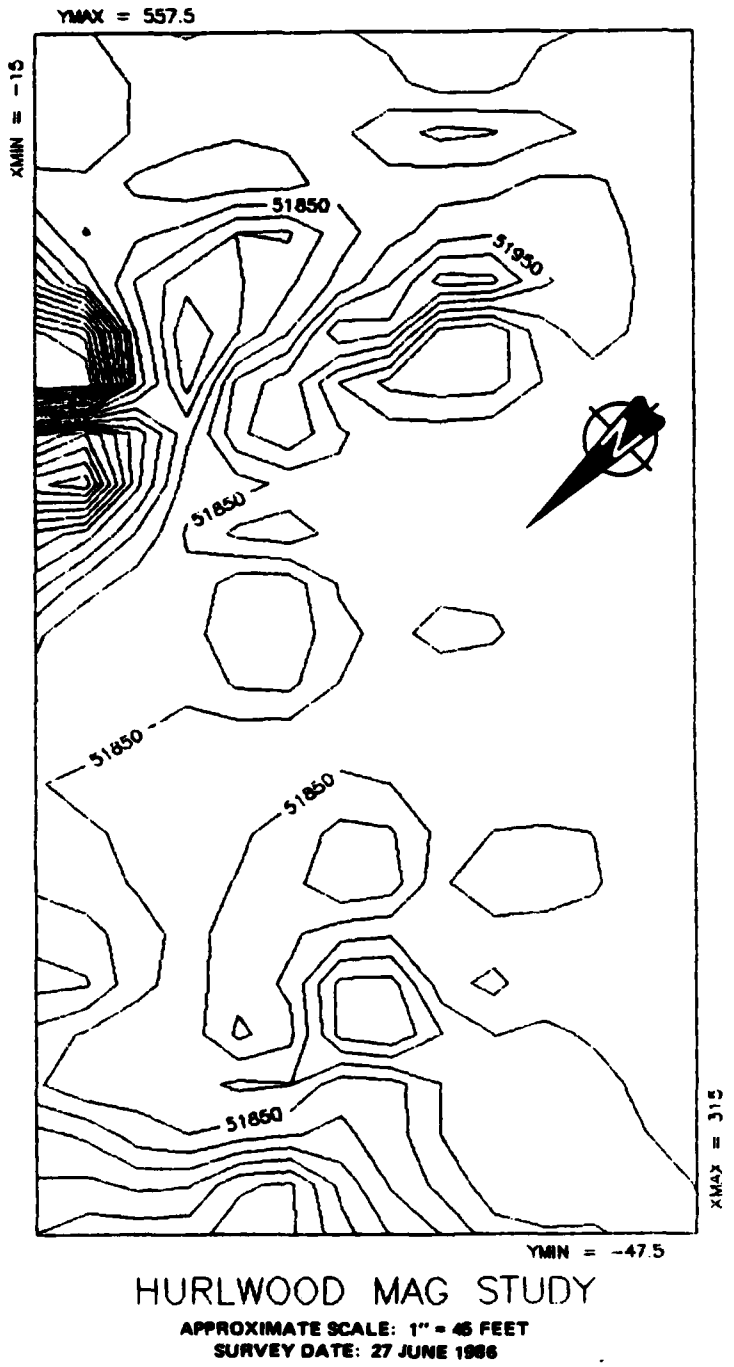


Figure 4–10 AREA 008 (HURLWOOD ACQUISITION AND LANDFILL D-7): MAGNETOMETER SURVEY PLOT

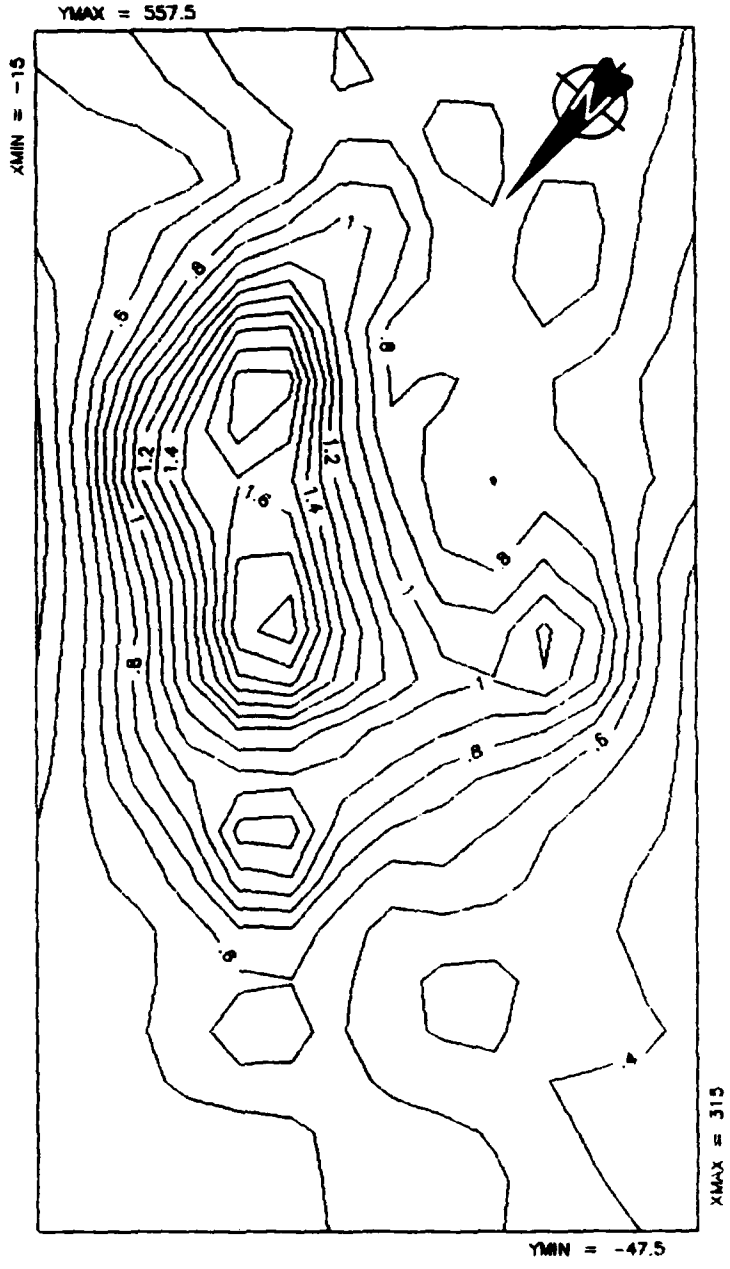


Figure 4–11 AREA 008 (HURLWOOD ACQUISITION AND LANDFILL D-7): EM SURVEY PLOT

Table 4-15

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 008
(HURLWOOD ACQUISITION AND LANDFILL, D-7)

(all units in mg/kg)

Parameter	Location: / Lab No: / Field No:	B1 1-2.5' 6871 9105	B1 15-16.5' 6872 9106	B1 24-25.5' 6873 9107	B2 1-2.5' 6874 9108	B2 15-16.5' 6875 9109	B2 17-18.5' 6876 9110	B1 1-2.5' 6877 9139	Threshold Concentration*	Method Detection Limit (mg/kg)
Arsenic		ND	7.8	ND	ND	ND	ND	ND	--	5.2**

ND - Not detected above method detection limits
*The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1).
**Elevated detection limit due to matrix interference.

Table 4-16

SUMMARY OF WATER SAMPLE ANALYSES FOR AREA 008
(HURLWOOD ACQUISITION AND LANDFILL, D-7)

(all units ug/L unless noted otherwise)

Parameter	Type:	Ground-water	Ground-water	Ground-water	Ground-water	Ground-water	Method Detection Limit (ug/L)	EPA MCL[1]	EPA RMCL[2]
	Location:	Well W1	Well W2	Well W3	Well W4	Well W5			
	Date:	8/18/86	8/18/86	8/18/86	8/19/86	8/19/86			
	Lab No:	7294	7295	7296	7326	7327			
	Field No:	9111	9112	9113	9114	9115			
Toluene		ND	ND	ND	1	ND	0.2	(200)	(2,000)
Di-n-butyl-phthalate		12	15	18	ND	ND	10	0.005[3]	--
Oil and grease*		0.5	0.5	0.5	0.4	0.5	0.2	--	--
Lead*		ND	0.008	0.008	ND	0.038	5	50	(20)
Zinc*		ND	0.30	0.18	0.10	2.9	50	2,000	--

ND - Not detected above method detection limits.
-- No standard or advisory given.
*Concentrations in mg/L.
[1]MCL - Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[2]RMCL - Recommended Maximum Contaminant Limits (proposed levels shown in parentheses, fixed levels shown without parentheses).
[3]Recommended Water Quality Criteria.

Arsenic was detected in one of the seven soil samples collected from the two boreholes. The arsenic concentration was 7.8 mg/kg.

Groundwater analysis indicated levels of lead and zinc in the groundwater; however, none of the concentrations reported were above primary or secondary drinking water standards. The concentrations ranged from 0.008 to 0.038 mg/L for lead and 0.10 to 2.9 mg/L for zinc. Oil and grease was reported for all five samples from 0.4 to 0.5 mg/L.

Organic analysis of the groundwater revealed one sample with a level of toluene above detection limits. Di-n-butyl phthalate was reported at levels of 12 to 18 ug/L.

4.1.9 Area 009: Sewage Digester Sludge Spreading Area (SS-1)

Analytical Results

Analysis of the soil samples indicated the presence of phthalates in six of the 22 samples. Three phthalate compounds were detected. These compounds were bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and di-n-octyl phthalate. The concentration range of these phthalate compounds from the 6 samples was 1.9 mg/kg to 8.6 mg/kg. Oil and grease concentrations were detected in 19 of the 22 samples. The oil and grease concentration range for the 19 samples was 146 mg/kg to 4,500 mg/kg.

Chromium, copper, and zinc were reported in every sample. Chromium levels ranged from 8 mg/kg to 15 mg/kg. Copper ranged from 3.6 mg/kg to 9.8 mg/kg. Zinc levels were reported from 17 mg/kg to 50 mg/kg. Lead was detected in 19 of the 22 soil samples (see Table 4-17). The lead concentration range of these 18 samples was 6.7 mg/kg to 72 mg/kg. Four of the lead samples had concentrations above the threshold concentration value.

Nickel was found in one sample at 12 mg/kg. Cadmium was reported in two samples at concentrations of 1.2 and 0.90 mg/kg.

4.2 SIGNIFICANCE OF FINDINGS

Based upon the results presented in Section 4.1, preliminary statements can be made regarding the presence or absence of contamination at each area investigated. When possible, a discussion of the

Table 4-17

SUMMARY OF SOIL SAMPLE ANALYSES FOR AREA 009
(SEWAGE DIGESTER SLUDGE SPREADING AREA, SS-1)

(all units in mg/kg unless noted otherwise)

Parameter	Location:	B1** 1-2'	B1 0-1'	B1** 1-2'	B2 0-1'	B2 1-2'	B3 0-1'	B3 1-2'	B4 0-1'	B4 1-2'	B5 0-1'	B5 1-2'	B6 0-1'	B6 1-2'
	Lab No.:	5761	5760	5762	5763	5764	5765	5766	5767	5768	5769	5770	5771	5772
	Field No.:	9117	9116	9118	9119	9120	9121	9122	9123	9124	9125	9126	9127	9128
Bis (2-ethyl hexyl) phthalate		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.1
Di-n-butyl phthalate		4.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate		ND	ND	ND	ND	ND	ND	ND	ND	1.9	ND	1.9	8.6	3.5
Oil and grease*		1600	3100	2300	1700	530	190	4500	2800	200	760	700	170	ND
Cadmium*		ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	0.90	ND	ND
Chromium*		10	8	9.1	7.4	10	12	8.9	13	13	8.9	11	10	15
Copper*		6	3.6	5.1	6.6	7.4	8.7	5	8.5	9	9.7	9.8	8.8	9.6
Lead*		ND†	ND†	ND†	70	24	10	6.7	66	23	71	72	30	14
Nickel*		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
Zinc*		26	17	21	35	32	35	21	46	36	40	49	40	39

Table 4-17 (Cont.)

Parameter	Location: / Lab No.: / Field No.:	B7 0-1' 5773 9129	B7 1'-2' 5774 9130	B8 0-1' 5775 9131	B8 1'-2' 5776 9132	B9** 0-1' 5777 9133	B9** 0-1' 5778 9134	B9 1'-2' 5779 9135	B10 0-1' 5780 9136	B10 1'-2' 5781 9137	Threshold Concentration††	Method Detection Limit (mg/kg)
Bis (2-ethyl hexyl) phthalate		ND	ND	ND	ND	ND	ND	ND	ND	ND	--	1
Di-n-butyl phthalate		ND	ND	ND	ND	ND	ND	ND	ND	ND	--	1
Di-n-octyl phthalate		2.6	ND	ND	ND	ND	ND	ND	ND	ND	--	1
Oil and grease*		270	370	150	150	170	170	150	260	ND	--	100
Cadmium*		ND	ND	ND	ND	ND	ND	ND	ND	ND	--	0.5
Chromium*		8.7	13	13	9.9	10	11	10	11	10	31.5	5
Copper*		7.3	8.7	8.6	8.2	8.3	8.5	8.1	9.1	8.2	11.2	2.5
Lead*		18	22	13	40	11	33	21	18	10	46.0	5
Nickel*		ND	ND	ND	ND	ND	ND	ND	ND	ND	--	10
Zinc*		29	36	50	44	36	33	30	35	30	50.7	4

ND - Not detected above method detection limits
*Concentrations in mg/kg
**QA/QC duplicate samples
†Elevated detection limits due to matrix interference.
††The concentration above which a sample's concentration can be considered a contaminant (see Section 4.1)

extent and migration potential has been provided. An evaluation of the contamination in terms of potential health and environmental hazard is presented for those compounds for which there are sufficient data and for which a basis of comparison is available.

The basis for determining the significance of the inorganics and organic compound concentrations in water are proposed or final MCLs and RMCLs, as set forth by the USEPA. MCLs and RMCLs have not been established for all compounds which were detected in groundwater. No standards or criteria have been established for concentrations of inorganics or organics in soils. Analysis for oil and grease, which is naturally occurring in both soils and waters, is non-specific.

Based upon the reported analyses, low-level concentrations of organic solvents and phthalates are present in the groundwater. The presence of phthalates may be anomalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC. These compounds were identified at similar concentrations in all groundwater samples from wells on the base and one well in the Hurlwood Acquisition. No concentration gradient was discernible and the source of the solvents is unclear.

4.2.1 Area 001: Industrial Waste Lake

Analytical results of the analysis of lake sediment samples at Area 001 show the presence of PNAs, typical of broad peak oily contamination, and four organic solvents. These compounds were detected in the sediment sample collected from the delta inlet. Discharge at this location is from waste waters from runways and other sources that has passed through an oil and grease separator. Two PNA compounds, pyrene and chrysene, were found at very low levels (3.2 and 2.1 ug/kg, respectively) in the lake inlet sediment. These results are consistent with wastes indigenous to airport operations (i.e., lubricants, cleaning solvents, etc.).

Concentrations of toluene (3.9 ug/L), 1,1,1-trichloroethane, (1.9 ug/L), and trichloroethene (0.22 and 0.27 ug/L), lead (0.006 and 0.007 ug/L), and zinc (0.25 ug/L) were detected in the groundwater. These concentrations were below current MCLs and RMCLs. Concentrations of 1,1,1-trichloroethane (0.57, 0.89, 3.9, and 7.1 ug/L), trichloroethene (0.51 and 0.59 ug/L), lead (0.010 ug/L), and zinc (0.015 ug/L) were

detected in the surface water. These concentrations were below current MCLs and RMCLs. Tetrachloroethene was detected in the surface water samples; however, no current EPA limits exist for comparison. Methylene chloride was detected in both the surface water and the groundwater; however, the concentrations detected are indicative of laboratory contaminants. Due to the limited amount of data available at this time, no conclusions can be reached regarding the source of groundwater contamination in this area. Further investigation is necessary to determine if a link exists between the groundwater contamination and the discharge to the lake.

One soil sample from a depth of 30 feet showed the presence of 4,4'-DDT at a concentration above the method detection limit. The presence of this pesticide is considered anomalous, since no other sample at the site indicated the presence of these pesticides.

No inorganics were reported which were in excess of method detection limits.

4.2.2 Area 002: Sewage Lake (Including Landfills D-3, D-4, and D-5, and Inactive Fire Training Area FT-3)

Subsurface soils from borehole B1 and monitoring well W1 showed the presence of oil and grease at levels in the range of 100 to 200 mg/kg. This concentration most likely indicates naturally occurring plant and animal degradation products.

Sediment samples showed the presence of low concentration of DDD and DDT. These are suspected to result from runoff from past pest-control operations on the golf course.

Surface water analysis from the second round of sampling showed the presence of chlorpyrifos and malathion. Also present at the pump discharge were concentrations of organic solvents, however these concentrations were at levels below current MCLs.

Groundwater contained toluene at a concentration below current MCLs. Groundwater also contained 1,1-dichloroethane (0.15 ug/L), but no current MCLs or RMCLs exist for comparison. Phthalates were also detected in the groundwater; however, all levels detected were below the EPA Recommended Water Quality Criteria.

The source of contamination in this area is uncertain; however, it may have been the result of previous pest control operations on the

golf course and the discharge of waters from the Industrial Waste Lake. Further investigation is necessary before any conclusions can be reached.

4.2.3 Area 003: POL Storage Area

Analytical results indicated the presence of lead and chromium in the majority of samples, but both were below the threshold concentrations. No correlation was found between the depths of the samples and the presence of metals; therefore, the levels appear to be within naturally occurring levels for these trace metals in soils. No background samples were taken to verify this.

Both oil and grease and petroleum hydrocarbon concentrations were detected in various samples. Oil and grease was detected above the method detection limit from soils collected from boreholes B2, B3, and B4. Petroleum hydrocarbons were not detected in the same soils. Because the analytical method for petroleum hydrocarbons differs from the analytical method for oil and grease only by the use of a cleanup column which removes animal fats and vegetable oils, it is likely that the positive values for oil and grease indicate natural biodegradation of organic material, not contamination from fuel-type sources. Petroleum hydrocarbons were detected above method detection limits in two soil samples from Borehole B1. Oil and grease was not detected in these two samples. According to the analytical methodologies, the oil and grease analysis is not applicable to light hydrocarbons ranging from gasoline to No. 2 fuel oil. These light hydrocarbons are completely or partially lost during solvent extraction. The petroleum hydrocarbon analysis is applicable to light hydrocarbons. Therefore, the positive petroleum hydrocarbon results may indicate the presence of some unknown light hydrocarbon, rather than the products of natural biodegradation. This may indicate a localized spill which migrated vertically.

4.2.4 Area 004: Southwest Landfill D-1

Analysis of soil samples showed no organic compounds present above method detection limits. Inorganic analysis indicated the presence of copper, chromium, nickel, zinc, and lead at concentrations below threshold values. No correlation as to contaminant depth could be drawn from the results as the concentrations varied in different

samples and from differing depths, so these values indicate naturally occurring levels.

Groundwater analyses showed the presence of organic solvents and phthalates. All but one of these compounds were below proposed MCLs or RMCLs. Trichloroethene was confirmed in both rounds of sampling at concentrations four to eight (24 to 41 ug/L) times the current proposed MCL (5 ug/L). The presence of phthalates may be anomalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC.

4.2.5 Area 005: Civil Engineering Paint Trench

Organic and inorganic analysis of subsurface soils showed no organics above detection limits and no metals in excess of threshold values.

Groundwater analysis indicated organic solvents below MCLs and low levels of phthalates. These levels were comparable to those found in groundwater samples from other sites. The presence of phthalates may be anomalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC. Based on the available data for this area, it was determined that no further investigation was required.

4.2.6 Area 006: Active Fire Training Area (FT-1) Including Drainage Impoundment (ST-3)

Analysis of subsurface soils showed lead levels, at concentrations within the threshold value. Chromium was found in two samples from B-1 (20 to 21.5 and 25 to 26.5 feet) at levels greater than the threshold value, and therefore may indicate the presence of contamination. However, based on the limited amount of available data, it is premature to draw any conclusions regarding health hazards (refer to Appendix M for a toxicological profile of chromium). Lead and chromium were also reported in the sediment samples, but at levels below calculated threshold values.

No organics other than oil and grease were reported in the subsurface soils or sediments above detection limits. The oil and grease values found may be due to natural degradation of organic material.

4.2.7 Area 007: Northwest Landfill/Rubble Area D-11

No inorganics were reported in excess of method detection limits at this site.

The only reported organic above detection limits was oil and grease. The soil sample from borehole B-4 had an oil and grease concentration of 1,500 mg/kg. This level does not appear to be due to natural degradation products and, therefore, indicates some contamination. The source of this contamination is unknown.

4.2.8 Area 008: Hurlwood Aquisition and Landfill D-7

Subsurface soil analysis indicated no organics above method detection limits.

Arsenic was reported at 7.8 mg/kg slightly above the detection limit in the soil from B-1, at 15 to 16.5 feet, and may indicate an anomalous value.

Toluene was reported in a single sample from well 4 at 1 ug/L, well below the EPA proposed RMCL of 2,000 ug/L. Low levels of phthalates (12 to 18 ug/L) were also reported in wells 1, 2, and 3. The presence of phthalates may be anamalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC.

Lead was detected in the groundwater samples collected from wells W2, W3, and W5. Zinc was detected in groundwater samples collected from wells W2, W3, W4, and W5. The lead concentration at Well 5 was 0.038 mg/L. Although this lead concentration is above the proposed RMCL (0.02 mg/L), the level does not exceed the current drinking water standard of 0.05 mg/L. Therefore, any potential negative health effects from consumption of this water are negligible. Zinc was detected in four samples (0.10 mg/L to 2.9 mg/L), but all levels were below the EPA secondary drinking water standard (5 mg/L).

4.2.9 Area 009: Sewage Digester Sludge Spreading Area (SS-1)

Organic analysis indicated soil contamination with oil and grease from slightly above the detection limit to as much as 4,500 mg/kg. The high level of oil and grease is probably the result of operations to construct a parking lot in 1985 when the area was shot with oil and ashphalt and then covered with gravel. Low levels of phthalates were

also reported with no discernible trend as to location or depth. The presence of phthalates may be anamalous, since solvents leach phthalates from PVC and the wells installed at Reese AFB were cased in PVC.

Several concentrations of lead were found in excess of the calculated threshold value, indicating potential contamination with this metal. The elevated levels of heavy metals, particularly lead, would indicate that these are not naturally occurring levels. However, with the limited amount of available data, it is premature to draw any conclusions regarding health hazards (see Appendix M). Cadmium was found in one boring at levels slightly above the detection level. Nickel was found in one boring also slightly in excess of the detection level. The remaining metals all were within the calculated threshold values.

The source of contamination in this area is uncertain; current information is not sufficient to rule out a link to past sludge-spreading operations.

Although Area 009 is underlain by the Ogallala aquifer, it is unlikely that the metals contamination would pose a threat because of the relatively impermeable barrier of caliche between Area 009 and the aquifer. Migration of metals due to surface runoff is also unlikely because most of Area 009 is paved. Any surface runoff generated at this area is collected by the storm drainage system and empties into the Industrial Waste Lake. Metals migration potential can be determined by conducting soil leachability tests.

4.2.10 Drill Cutting EP Tox Testing

The drill cuttings from Areas 001, 002, 003, 004, 006, 007, and 008 were drummed and later analyzed for EP TOX leachability parameters. All samples were negative for all EP TOX parameters. The cuttings were considered clean and were then placed in active areas of the southwest landfill as directed by base personnel. EP TOX data are presented in Appendix H along with other sampling data.

5. ALTERNATIVE MEASURES

Major alternative measures applicable to the investigation areas at Reese AFB can be placed into three general categories, including no action; additional fieldwork; and remedial actions. These alternatives are discussed below.

- Alternative 1 - No further action (including remedial action) is required since the results of the investigation show no significant health or environmental hazards. This corresponds to Air Force IRP Category I (see Section 6);

- Alternative 2 - Additional fieldwork to define the location, nature, and extent of contamination. This alternative corresponds to Air Force IRP Category II. This could include:

  - Additional records search, aerial photographic interpretation, or further geophysical surveys to define locations of contaminated areas;

  - Drilling of boreholes and installation of monitoring wells and subsurface soil and groundwater to define the nature and extent of subsurface contamination; and

  - Additional sediment and surface water sampling to define nature and extent of surface contamination.

- Alternative 3 - Remedial actions. These actions include various removal, containment, and treatment options. These alternatives correspond to Air Force IRP Category III.

As a result of the low level groundwater contamination at many areas in the form of organic solvents and phthalates, a general Alternative 2 is recommended for Reese AFB. This work would include the collection of groundwater samples from existing upgradient wells off the base to the west, and the installation of two to three upgradient shallow borings on the base to determine background levels of the solvents and phthalates.

In addition to the general alternative recommended for the entire base, the alternatives applicable to individual areas are presented below:

5.1 AREA 001 (INDUSTRIAL WASTE LAKE SI-1)

Alternative 2, additional fieldwork, is applicable to this area. Additional fieldwork should take the form of continued characterization of the lake sediments and lake waters. The purpose of this sampling is to monitor the discharge to the inlet delta, especially for PNAs and organic solvents.

5.2 AREA 002 (SEWAGE LAKE INCLUDING LANDFILLS D-3, D-4, D-5 AND INACTIVE FIRE TRAINING AREA FT-3)

Alternative 2, additional fieldwork, is applicable to this area. Pesticides found were at low concentrations and migration is prevented by clay soils at the site; however, the landfills and the FPTA associated with this area have not been fully investigated.

5.3 AREA 003 (POL STORAGE AREA)

Alternative 1, no action, is applicable to this area since no significant contamination was found.

5.4 AREA 004 (SOUTHWEST LANDFILL D-1)

Alternative 2, additional fieldwork, is applicable to this area in the form of additional subsurface soil sampling to define the extent of the inorganic contaminants found at the perimeter of the

site. Additional groundwater sampling is needed to verify the trichloroethene contamination and to define the source.

5.5 AREA 005 (CIVIL ENGINEERING PAINT TRENCH)

Alternative 1, no action, is applicable to this area since no significant contamination was detected.

5.6 AREA 006 (ACTIVE FIRE TRAINING AREA FT-1 INCLUDING DRAINAGE IMPOUNDMENT SI-3)

Alternative 2, additional fieldwork, is applicable to this area in the form of additional sediment sampling and the drilling of borings and the sampling of subsurface soils to determine if chromium contamination is more extensive.

5.7 AREA 007 (NORTHWEST LANDFILL D-11)

Alternative 1, no action, is applicable to this area since no significant contamination was detected. Soils at the area are tight clays and silts and would retard any potential contaminant migration.

5.8 AREA 008 (HURLWOOD ACQUISITION AND LANDFILL D-7)

Alternative 2, further fieldwork, is applicable in the form of additional subsurface soil borings in the area of B-1 (see Figure 3-2) to define the extent and source of the arsenic contamination.

5.9 AREA 009 (SEWAGE DIGESTER SLUDGE SPREADING AREA SS-1)

Alternative 2, further fieldwork, is applicable at this area. The further fieldwork should take the form of additional soil borings to define the vertical and lateral extent of the metals contamination. Leachability tests should be conducted on soils collected from this area to determine the potential for metals migration.

6. RECOMMENDATIONS

The following recommendations are based upon the results of the Phase II Stage 1 investigation. Each Area, in accordance with the Description of Work, has been listed by Category (Category I, II, or III). Category I sites, where adequate data exists to rule out public health or environmental hazard, require no further action. Category II sites require Phase II Stage 2 investigations to better quantify or assess the extent of contamination. Category III sites require remedial actions as part of Phase IV. No Category III sites were designated. Table 6-1 lists the sites by category. Category II sites have been prioritized. General and site-specific recommendations for Phase II Stage 2 are presented below.

6.1 GENERAL RECOMMENDATIONS

The low level contamination of groundwater by organic solvents and phthalates found in all of the groundwater samples taken at the base requires that a background level of these compounds be established. Credible background levels can best be obtained from off-base locations. Samples should be taken from existing off-base wells, if available. Similar background data should be developed for inorganics as well as organics for soils. The drilling of three boreholes in an area of the base judged to be free of contamination and the sampling of the subsurface soils at depths of 3, 5, 15, and 30 feet (or refusal) will accomplish this goal. The groundwater samples should be analyzed for purgeable organic compounds (EPA 601/602). The subsurface soil samples should be analyzed for oil and grease and metals.

Table 6-1

LIST OF AREAS BY CATEGORY

Category I

- Area 003: POL Storage Area SP-1
- Area 005: Civil Engineering Trench SI-4
- Area 007: Northwest Landfill D-11

Category 2

- General: Groundwater and off-site soils adjacent to the base should be investigated to define background and general groundwater contaminant levels.
- Area 001: Industrial Waste Lake SI-1
- Area 002: Sewage Lake including Landfills D-3, D-4, D-5, and Inactive Fire Training Area FT-3
- Area 004: Southwest Landfill D-1
- Area 006: Active Fire Training Area (FT-1) Including Drainage Impoundment (SI-3)
- Area 008: Hurlwood Acquisition and Landfill D-7
- Area 009: Sewage Digester Sludge Spreading Area SS-1

6.2 AREA 001 (INDUSTRIAL WASTE LAKE)

Category II. Because of the levels of PNAs and solvents detected in the sediments and water in the Industrial Waste Lake, additional monitoring of the sediments and water is recommended. It is suggested that sample collection be correlated with discharge to the lake. Sediment samples should be collected at the inlet delta. The water sample location should coincide with the Stage 1 location (see Figure 3-2). To determine if a link exists between discharge to the lake and groundwater contamination, one additional monitoring well (a deep well) should be constructed downgradient of the lake (see Figure 6-1). Groundwater samples should be taken quarterly; however, the sampling frequency will be reduced when sufficient data are collected showing no increasing trends in previously identified contaminants and when concentrations are below allowable levels. The water and sediment samples should be analyzed for purgeable organics (EPA 601/602) and BNAs.

6.3 AREA 002 (SEWAGE LAKE, ASSOCIATED LANDFILLS D-3, D-4, D-5 AND INACTIVE FIRE TRAINING AREA FT-3)

Category II. The landfills and the FPTA associated with this area have not been fully investigated. It is suggested that more detailed geophysical surveys (EM and magnetometer) be performed in the vicinity of the fire training area and landfill D-4 to better define the boundaries. One additional well should be placed upgradient (west) of the sewage lake, and one downgradient well should be placed in the southeast corner of the base, to determine the effect of this area as a potential source of contaminants in the groundwater (see Figure 6-1). Groundwater samples will be taken at the same frequency as Area 001 wells. Also, a minimum of two additional borings should be made around each of the landfills to determine whether they are leaching contaminants.

6.4 AREA 003 (POL STORAGE AREA SP-1)

Category I. Since no significant contamination was detected, no further action is recommended.

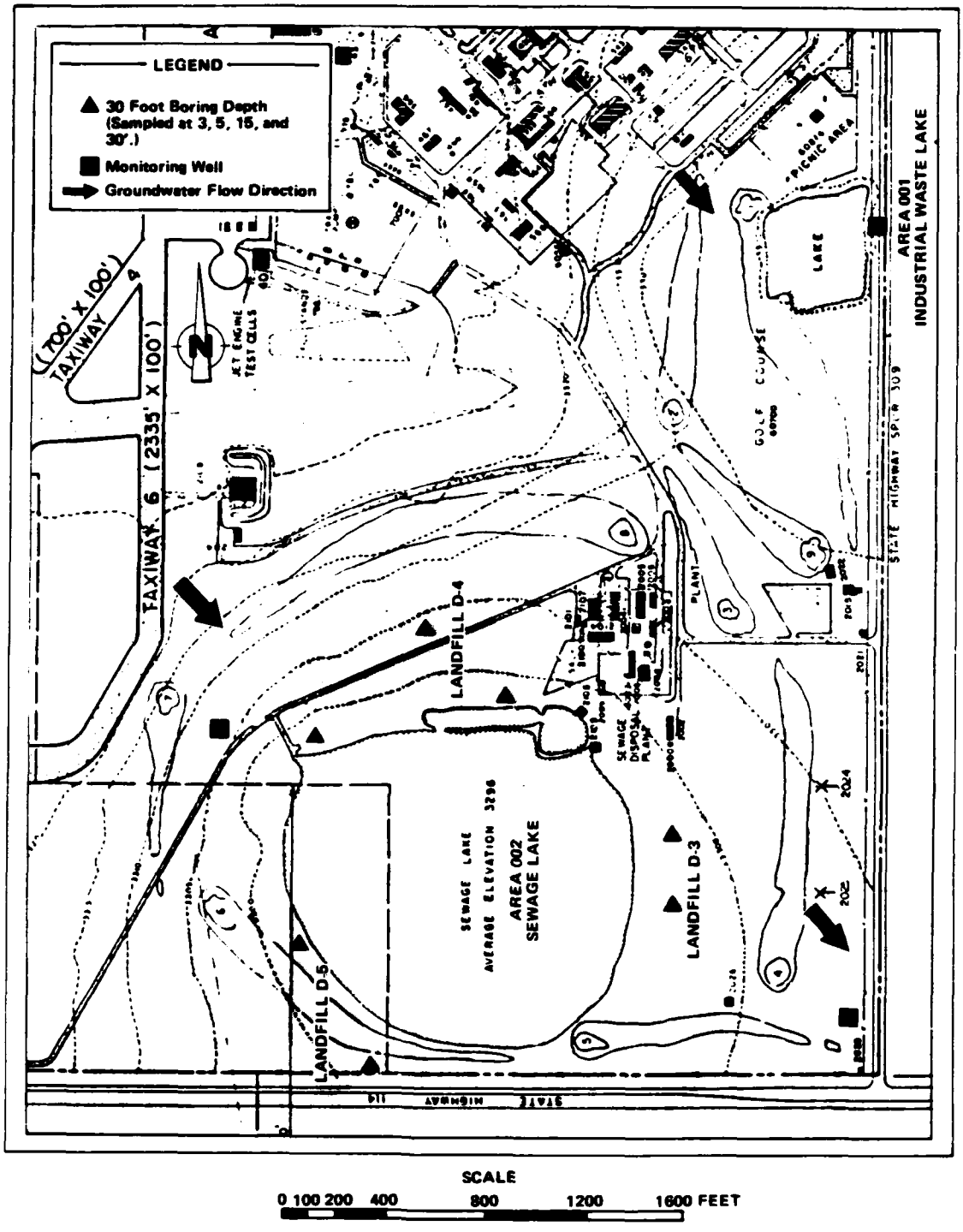


Figure 6–1 RECOMMENDED BORING AND MONITORING WELL LOCATIONS FOR AREAS 001 AND 002

6.5 AREA 004 (SOUTHWEST LANDFILL D-1)

Category II. Because of the apparent groundwater contamination at this site, resampling of the monitoring well installed during this investigation is recommended (the recommended general base sampling may provide applicable data). To attempt to define the extent of inorganic migration, a series of six 30-foot borings should be located beyond the Stage 1 borings (see Figure 6-2). Both the groundwater and soil samples will be analyzed for arsenic, copper, chromium, lead, and zinc.

6.6 AREA 005 (CIVIL ENGINEERING TRENCH SI-4)

Category I. Because no significant contamination was found at Area 005, no further action is recommended.

6.7 AREA 006 (ACTIVE FIRE TRAINING AREA FT-1 INCLUDING DRAINAGE IMPOUNDMENT SI-3)

Category II. The extent of chromium contamination at Area 006 is yet undetermined. It is recommended that six additional 30-foot borings with subsurface soil sampling be undertaken at locations adjacent to but farther from the Fire Training Area (see Figure 6-2). The soil samples should be taken at depths of 3, 5, 15, and 30 feet (or refusal). Additionally, eight to 10 sediment samples (0 to 1-foot depths) should be taken in the drainage impoundment and analyzed for chromium to define the extent of contamination.

6.8 Area 007 (NORTHWEST LANDFILL D-11)

Category I. Since no significant contamination was found, no further action is recommended.

6.9 Area 008 (HURLWOOD ACQUISITION AND LANDFILL D-7)

Category II. The extent of the arsenic contamination and its source have not yet been defined. It is recommended that three additional 30-foot borings be located along the eastern perimeter of D-7 (see Figure 6-3). Samples should be collected at 3, 5, 15, and 30 feet (or refusal) and analyzed for arsenic. Although lead and zinc levels in one of the wells were above the RCML and MCL, respectively,

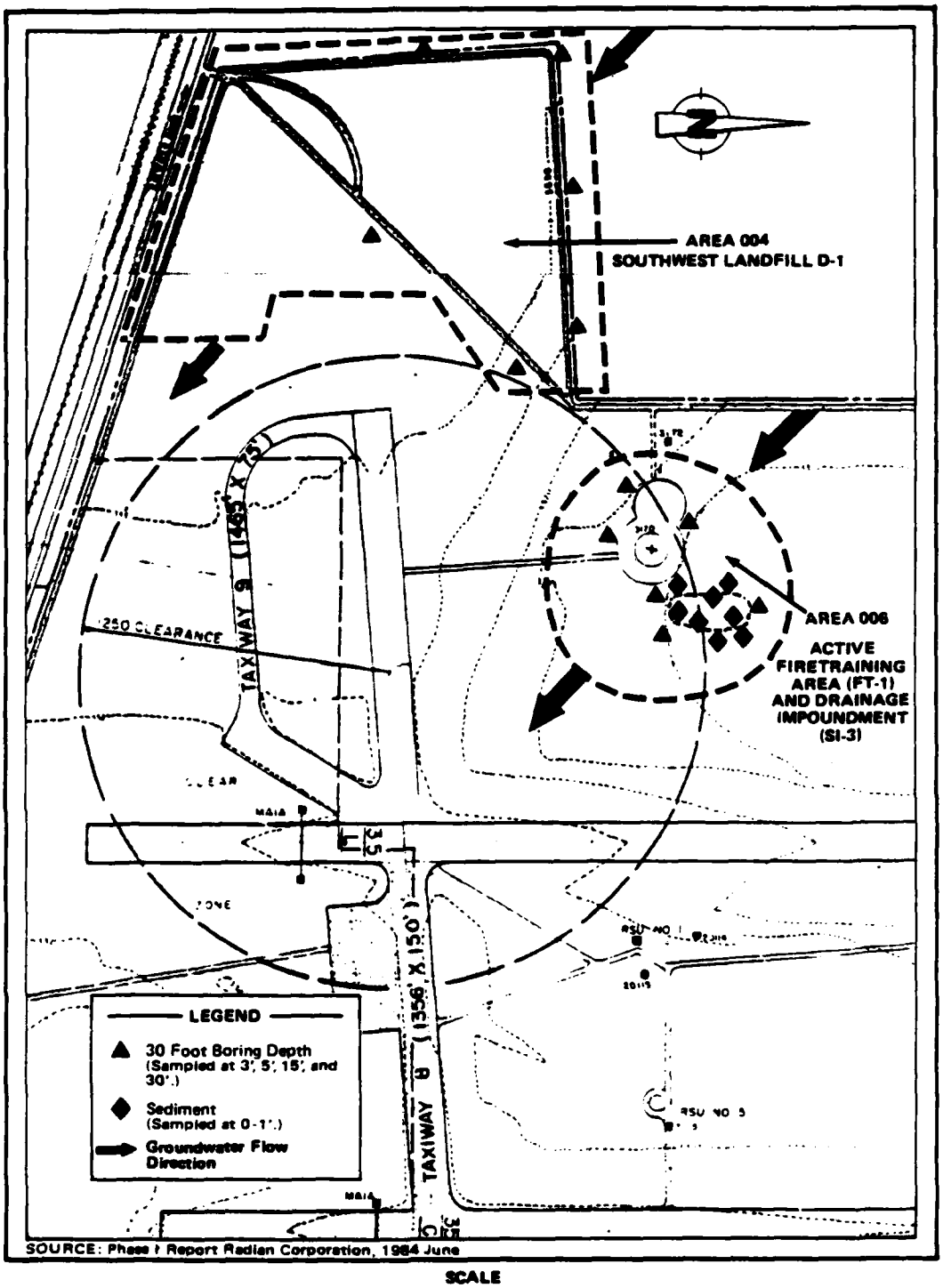


Figure 6–2 RECOMMENDED BORING LOCATIONS FOR AREAS 004 AND 006

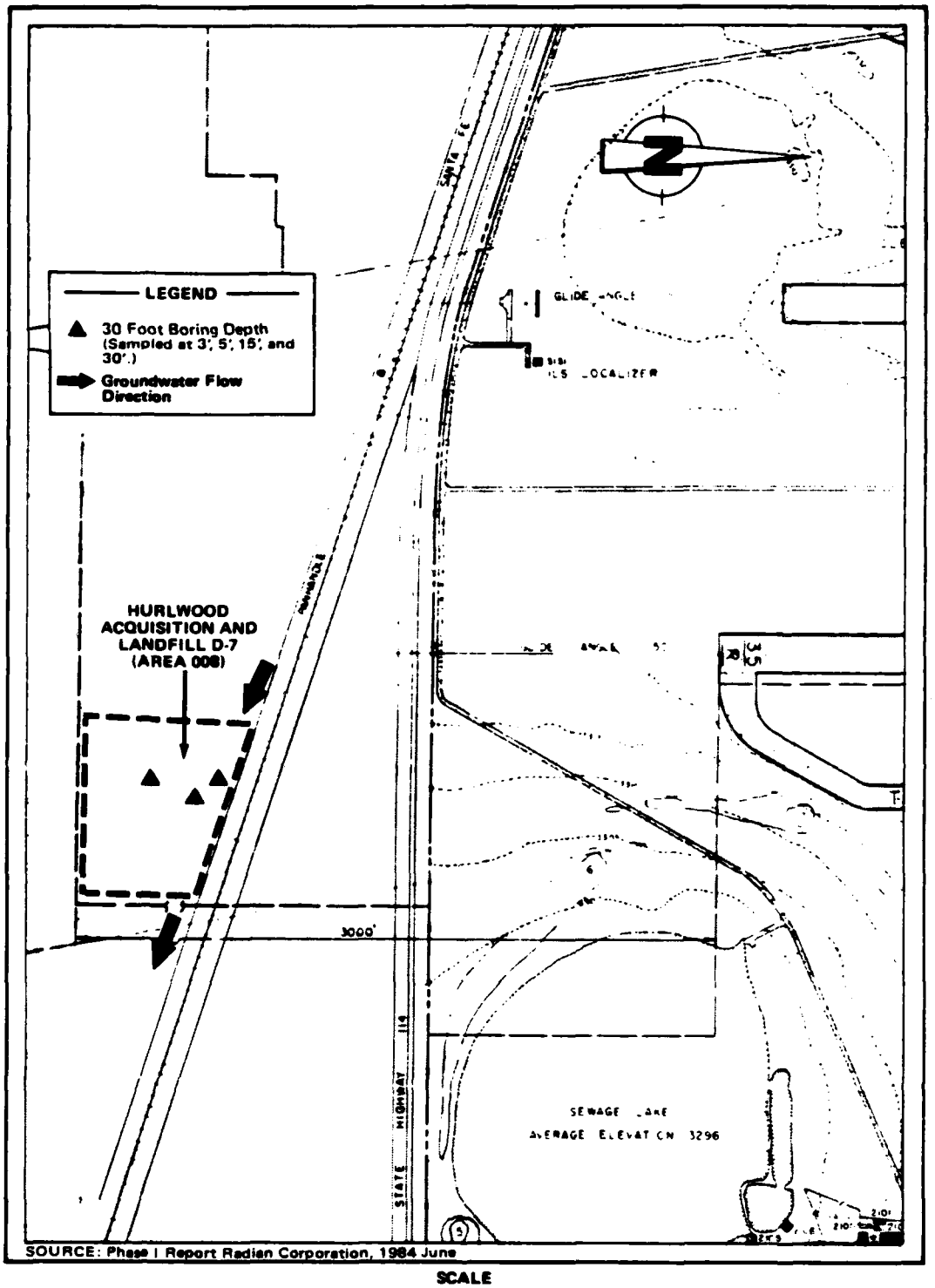


Figure 6–3 RECOMMENDED BORING LOCATIONS FOR AREA 008

the concentrations were below EPA drinking water standards. Therefore, no additional groundwater sampling is proposed

6.10 Area 009 (SEWAGE DIGESTER SLUDGE SPREADING AREA SS-1)

Category II. Although the metals detected are typical of sewage sludge, the actual extent of these metals is not well defined. It is recommended that four 6-foot borings and six 3-foot borings be installed to define the vertical depth of the metals (see Figure 6-4). Samples should be analyzed for arsenic, cadmium, chromium, copper, lead, nickel, and zinc. The metals found are essentially immobile and should not migrate.

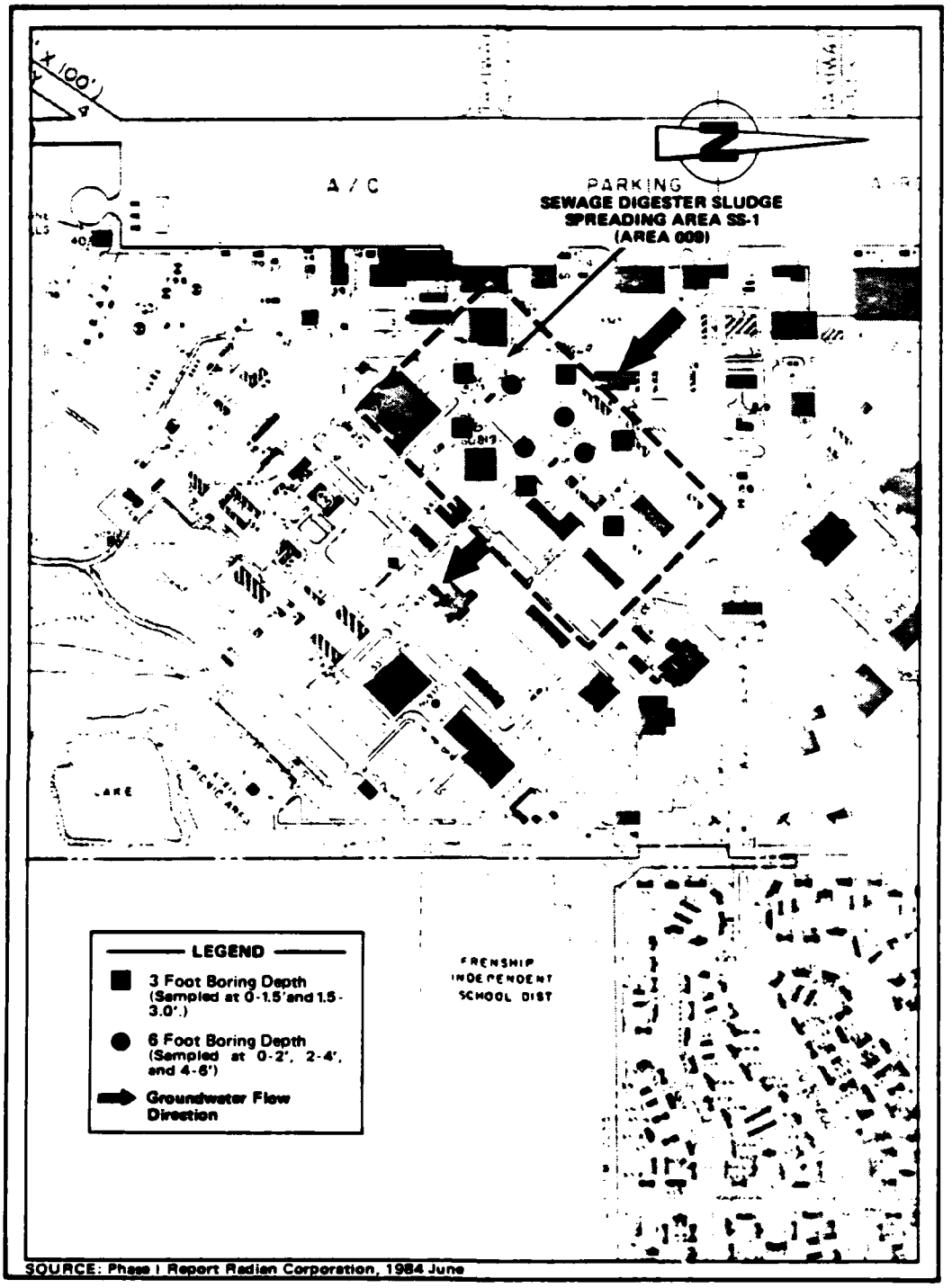
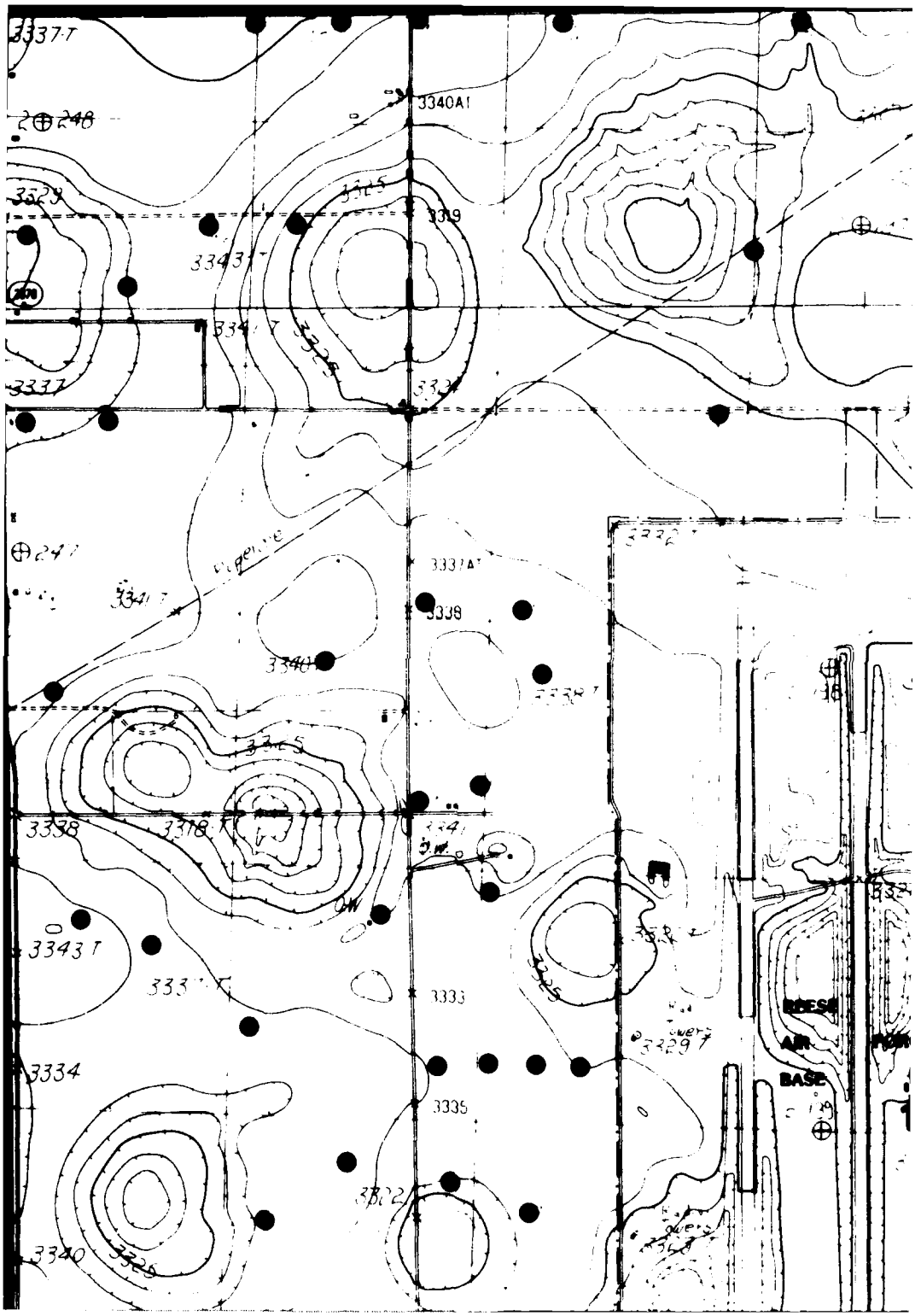
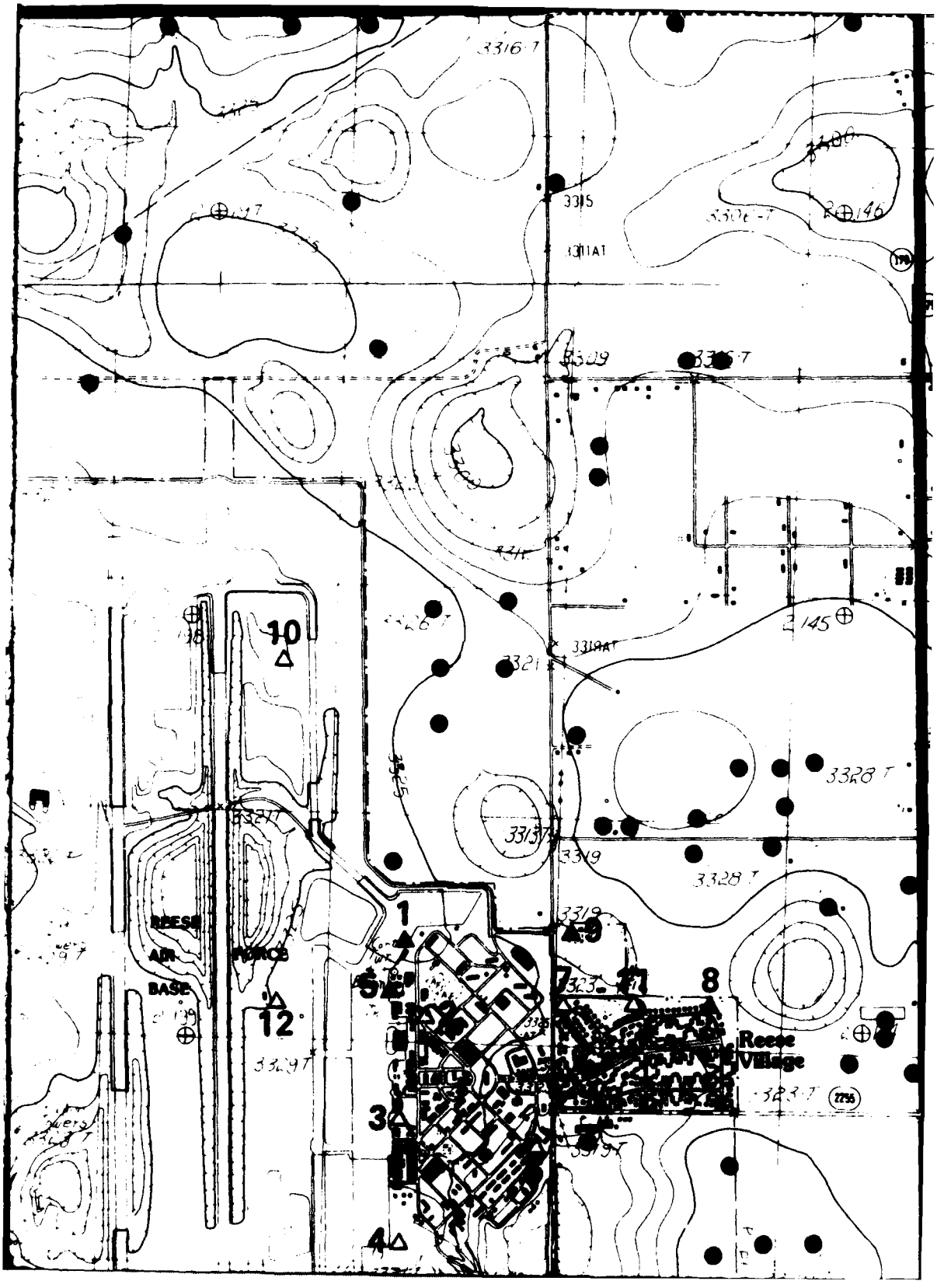
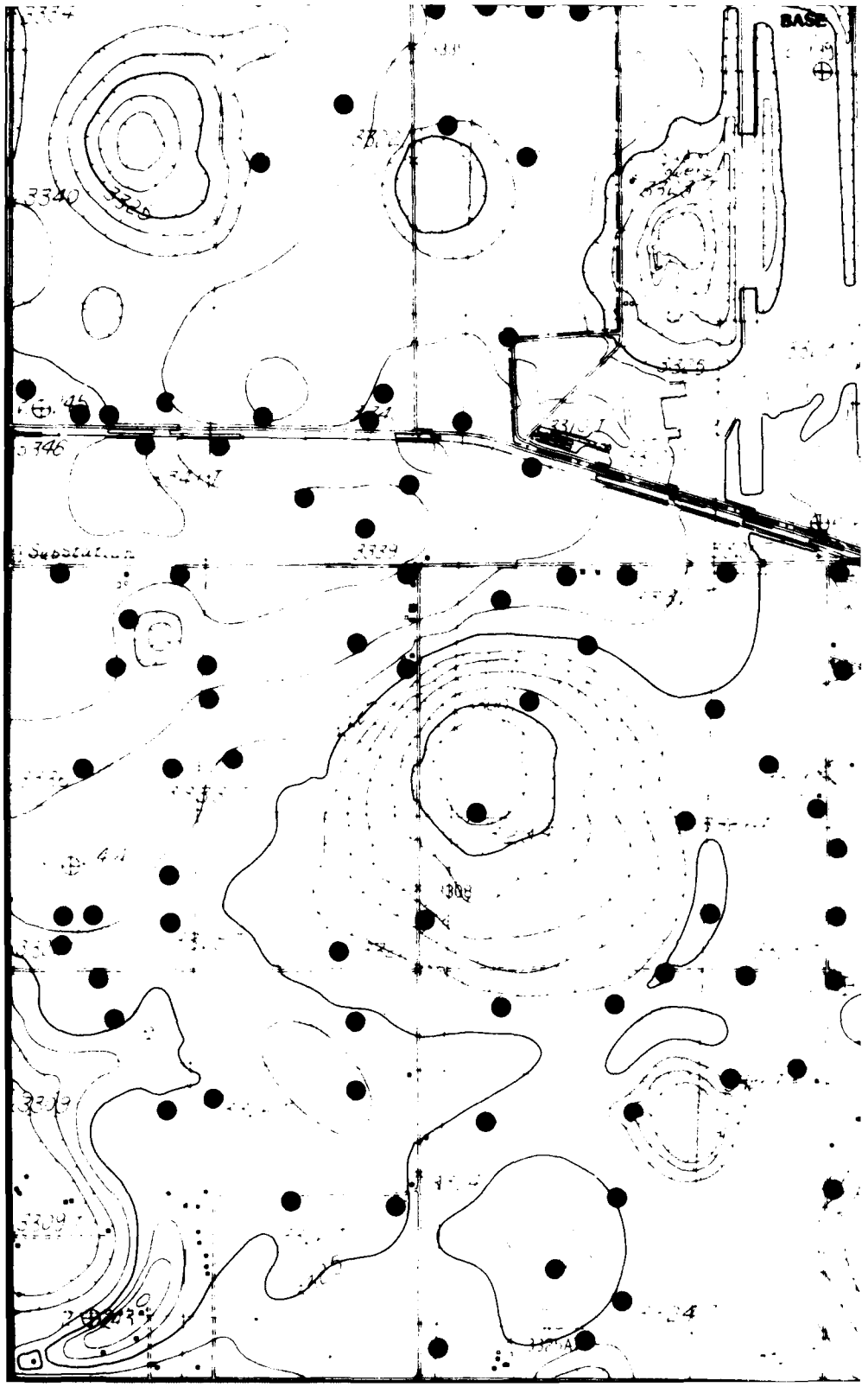


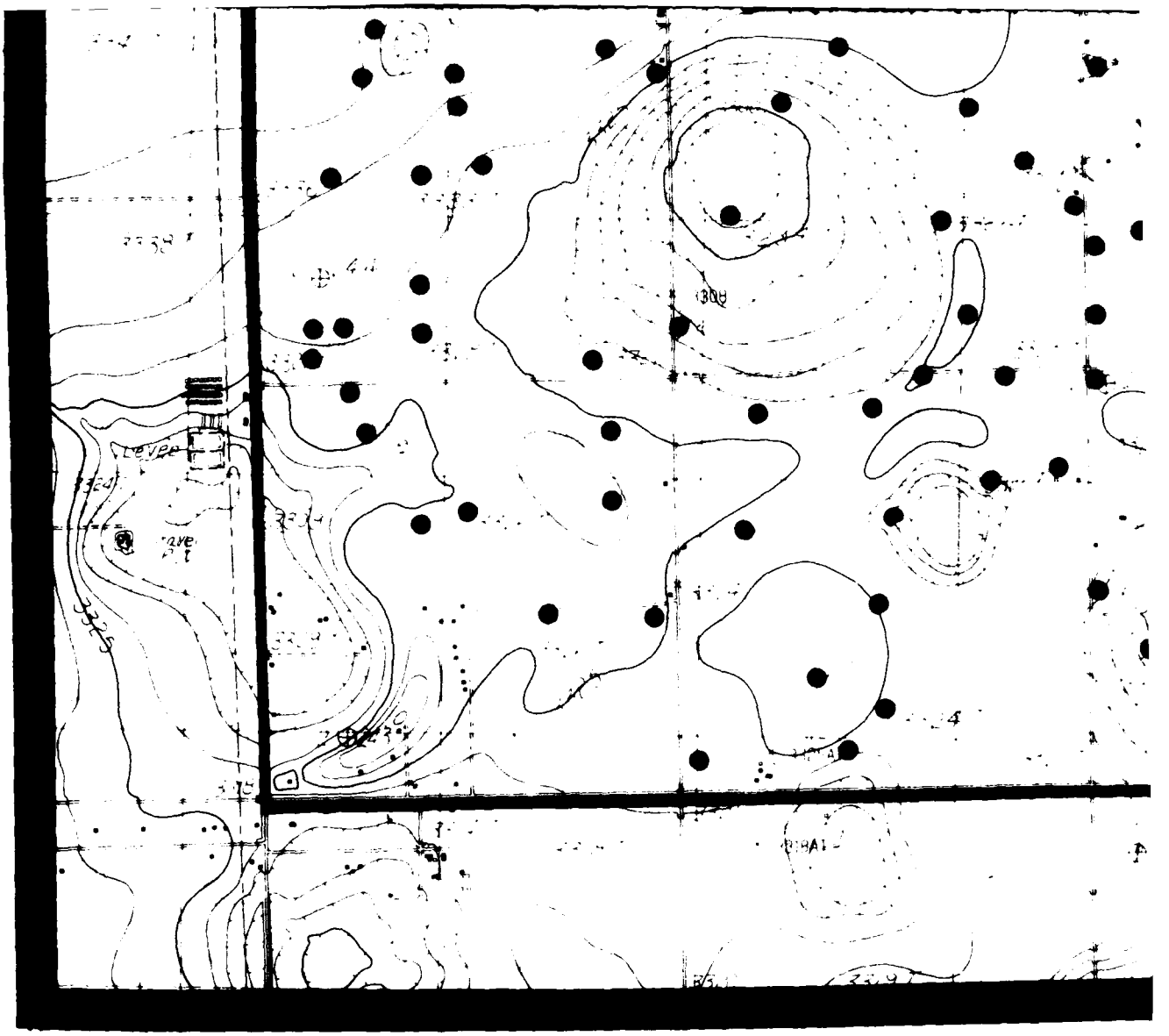
Figure 6–4 RECOMMENDED BORING LOCATIONS FOR AREA 009


3337
3340A1
3339
3343
3337
3331A
3338
3340
3338
3343
3333
3334
3335
3340
BOISE
AIR
BASE


10
12
1
5
7
8
3
4
REESE
AIR
FORCE
BASE
Reese
Village


BASE
3340
3329
3326
3346
Substation
3324
3309


AIR FORCE BASE
Reese Village
Hurlwood
Lubbock



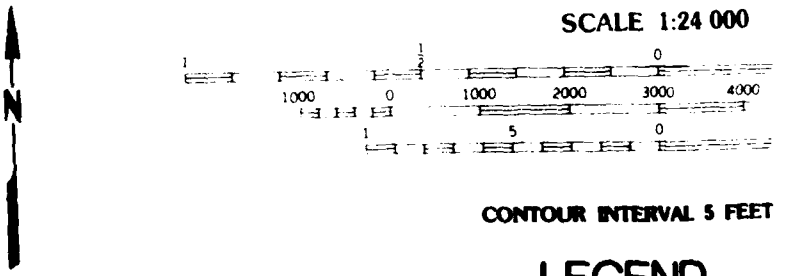
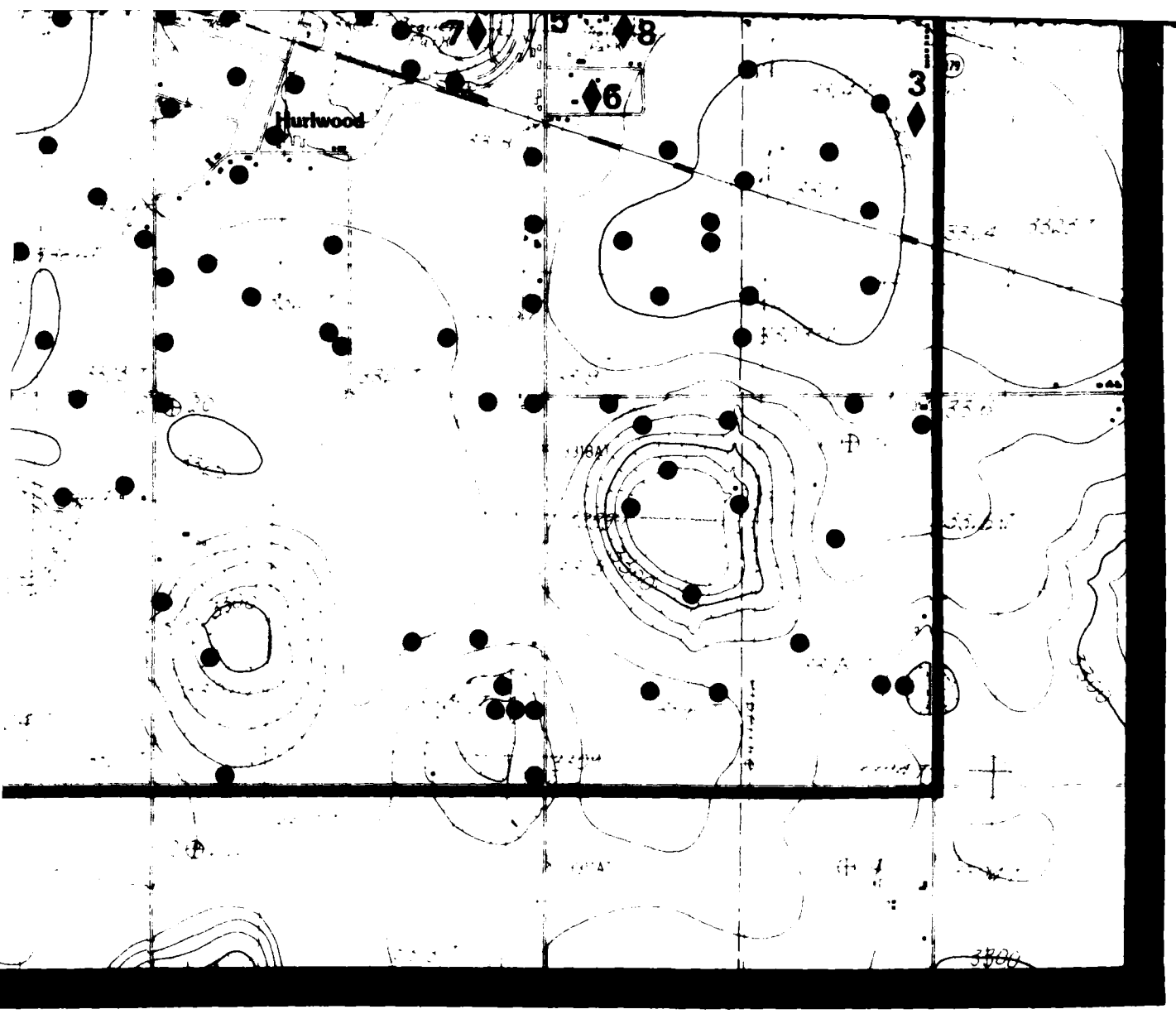


Figure 2–4

COMMUNITY AND BASE WELL LOCATIONS WITHIN ONE-MILE RADIUS OF REESE AFB

5



SCALE 1:24 000

0 1 MILE

2000 3000 4000 5000 6000 7000 FEET

0 1 KILOMETER

CONTOUR INTERVAL 5 FEET

WOLFFORTH QUADRANGLE
WOLFFORTH NE QUADRANGLE
TEXAS
7.5 MINUTE SERIES (TOPOGRAPHIC)
PROVISIONAL EDITION 1985

LEGEND

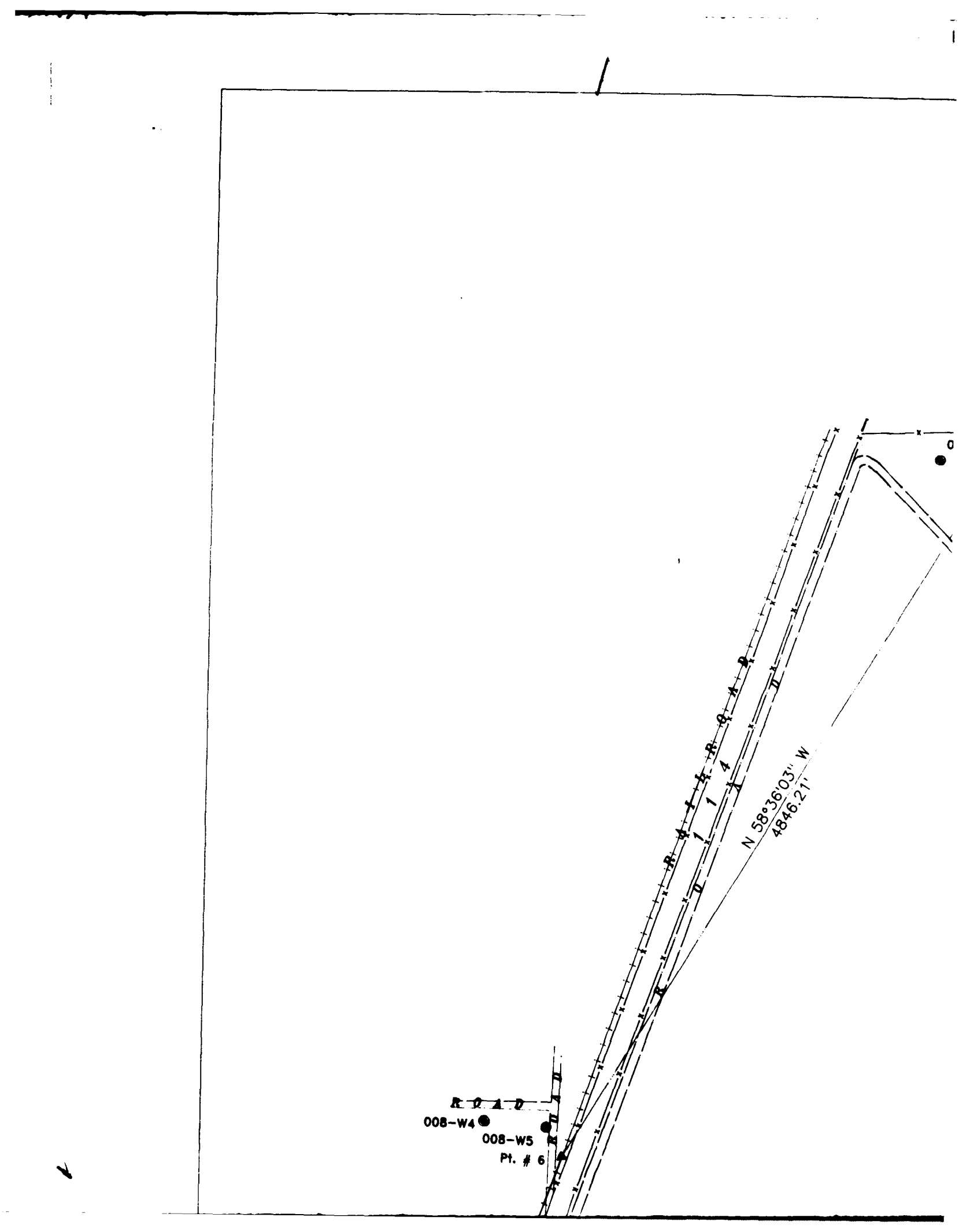
IRRIGATION WELL
ACTIVE AF BASE WELL
NON-ACTIVE AF BASE WELL
COMMUNITY WELL
SURVEY BOUNDARY

NOTE: ALL HOUSES IN SURVEY AREA ARE REPORTEDLY ON WELL WATER.

MAY 4 1988

1

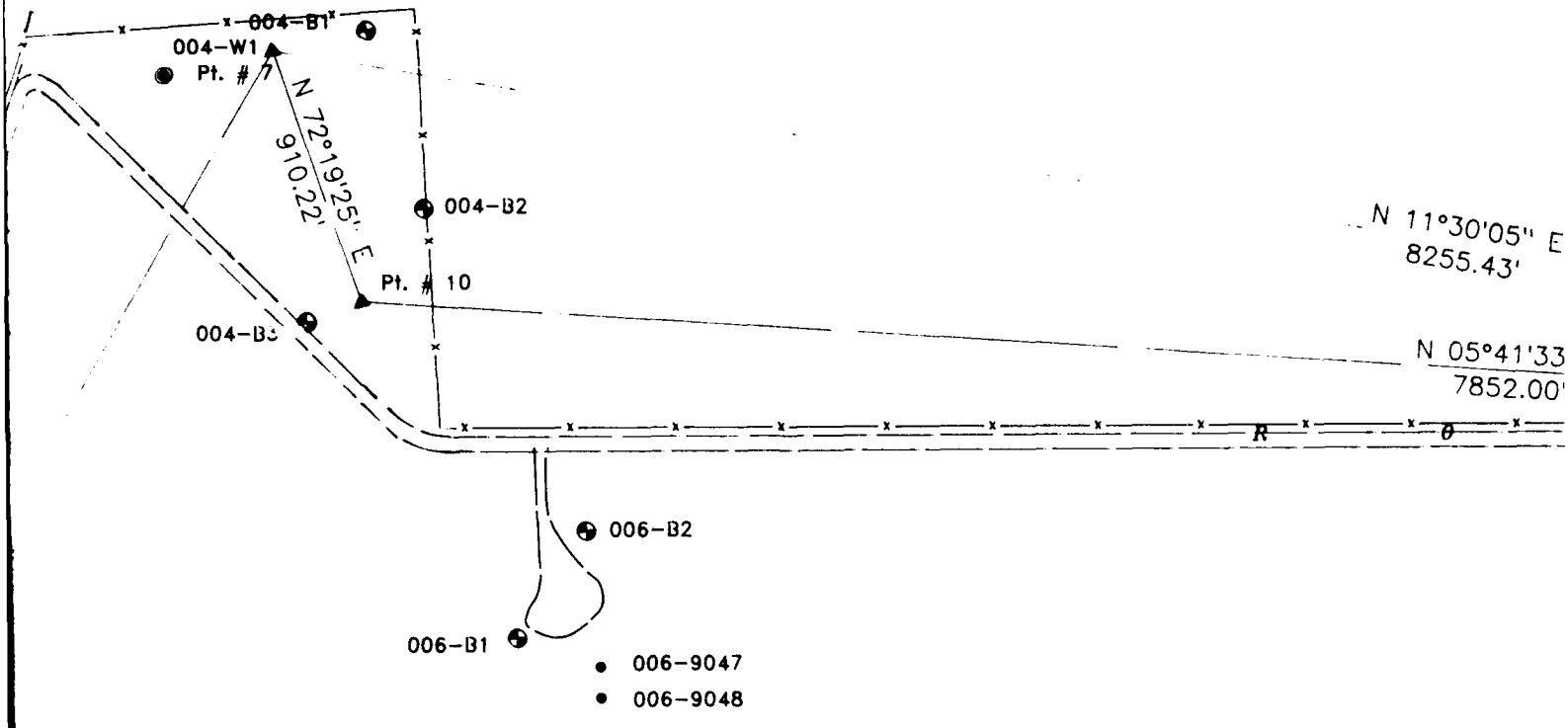
6


ROAD
008-W4
008-W5
Pt. # 6
N 58°36'03" W
4846.21'

1 2

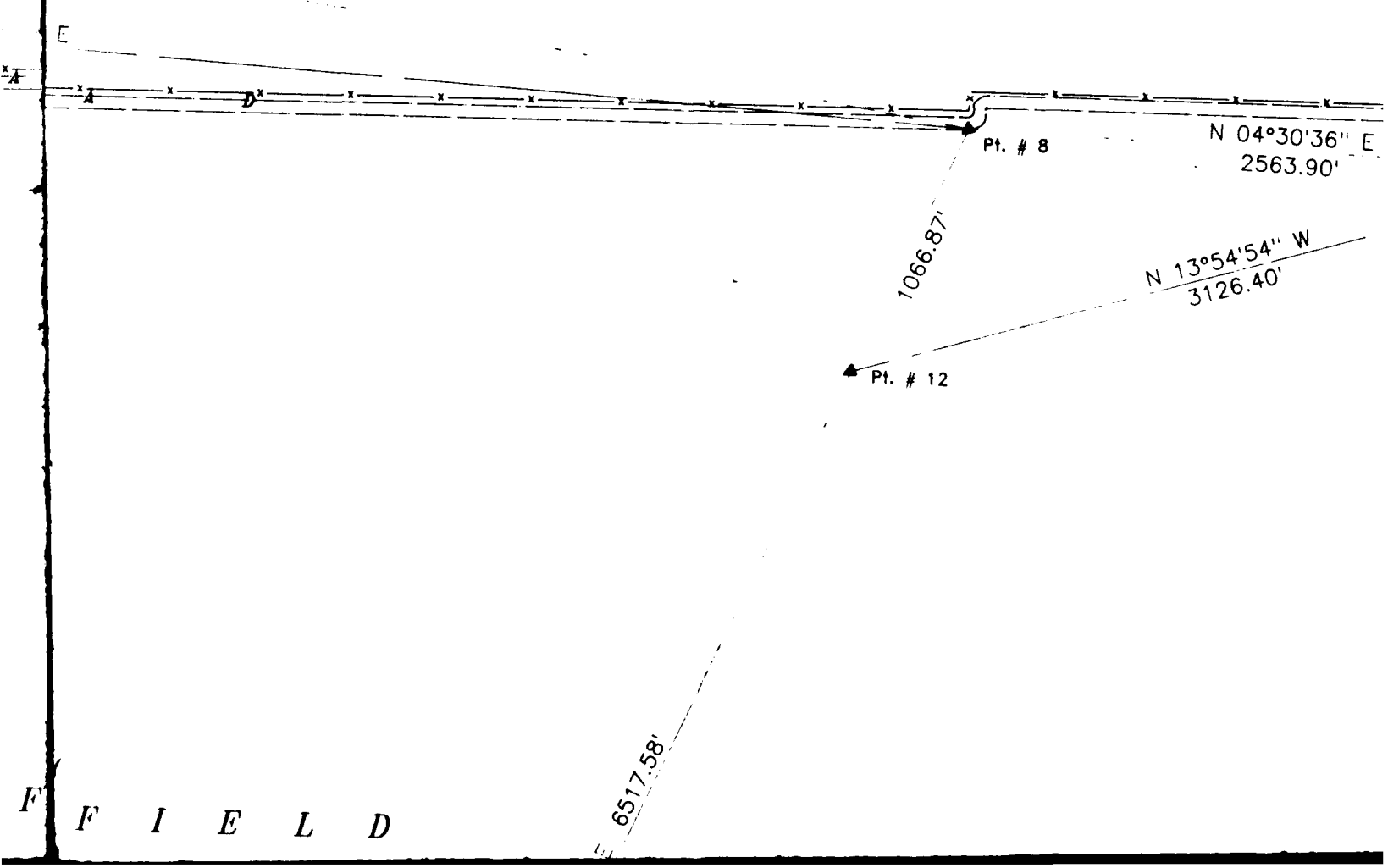
Water wells, bo

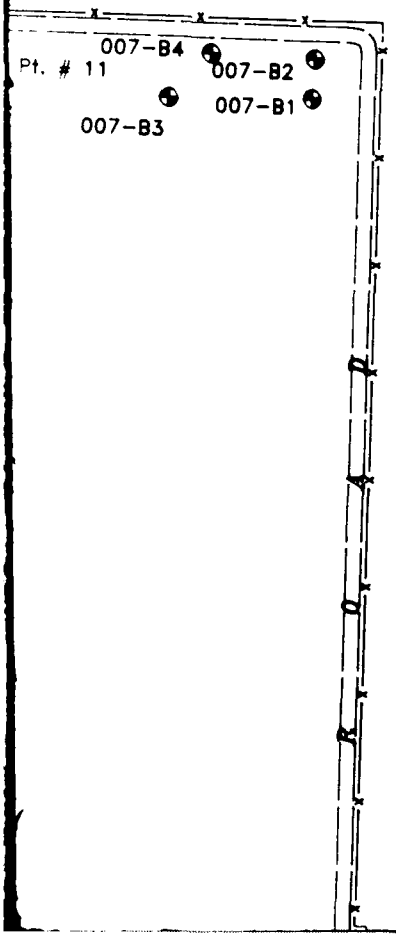
L



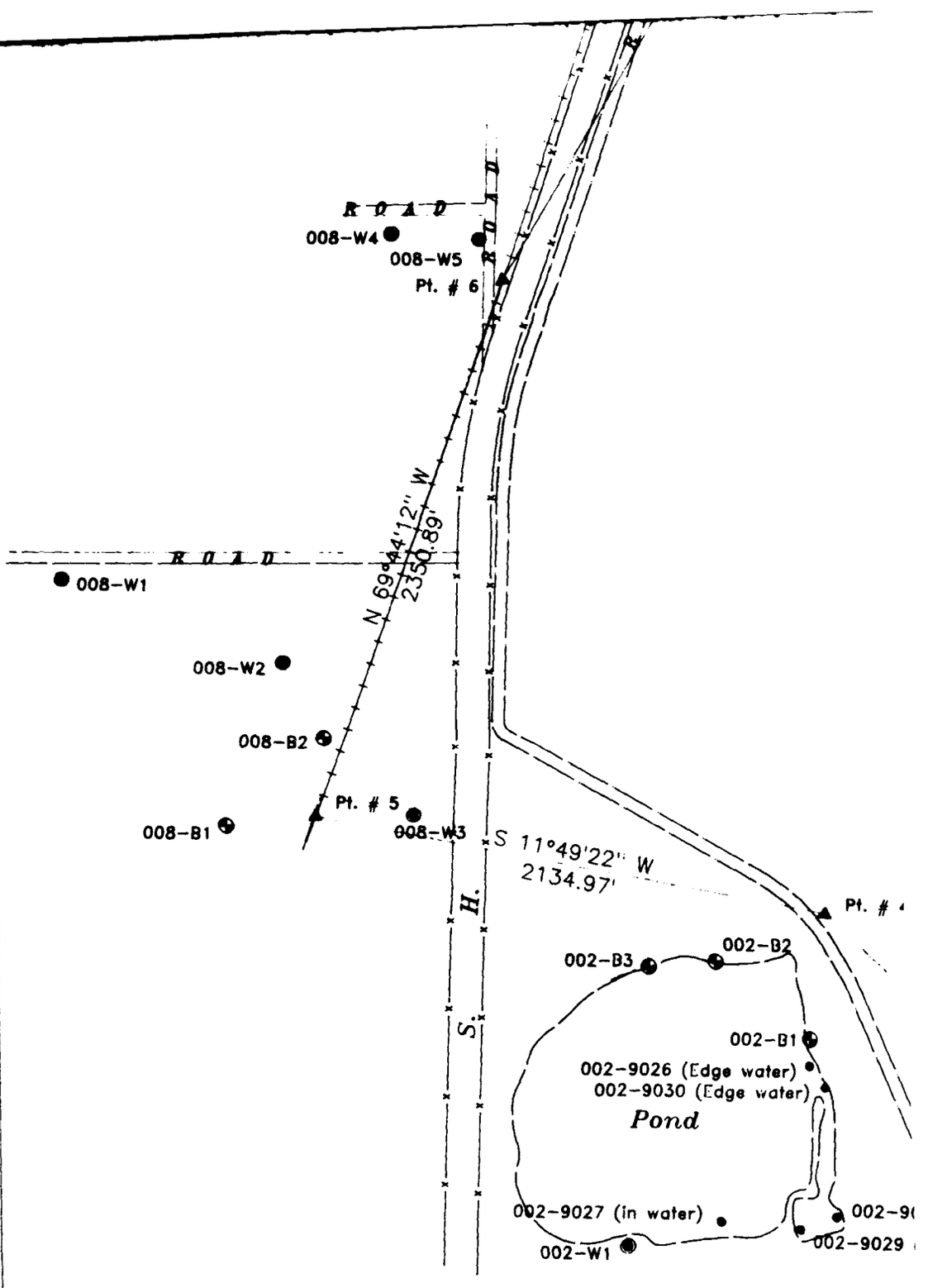
A I F

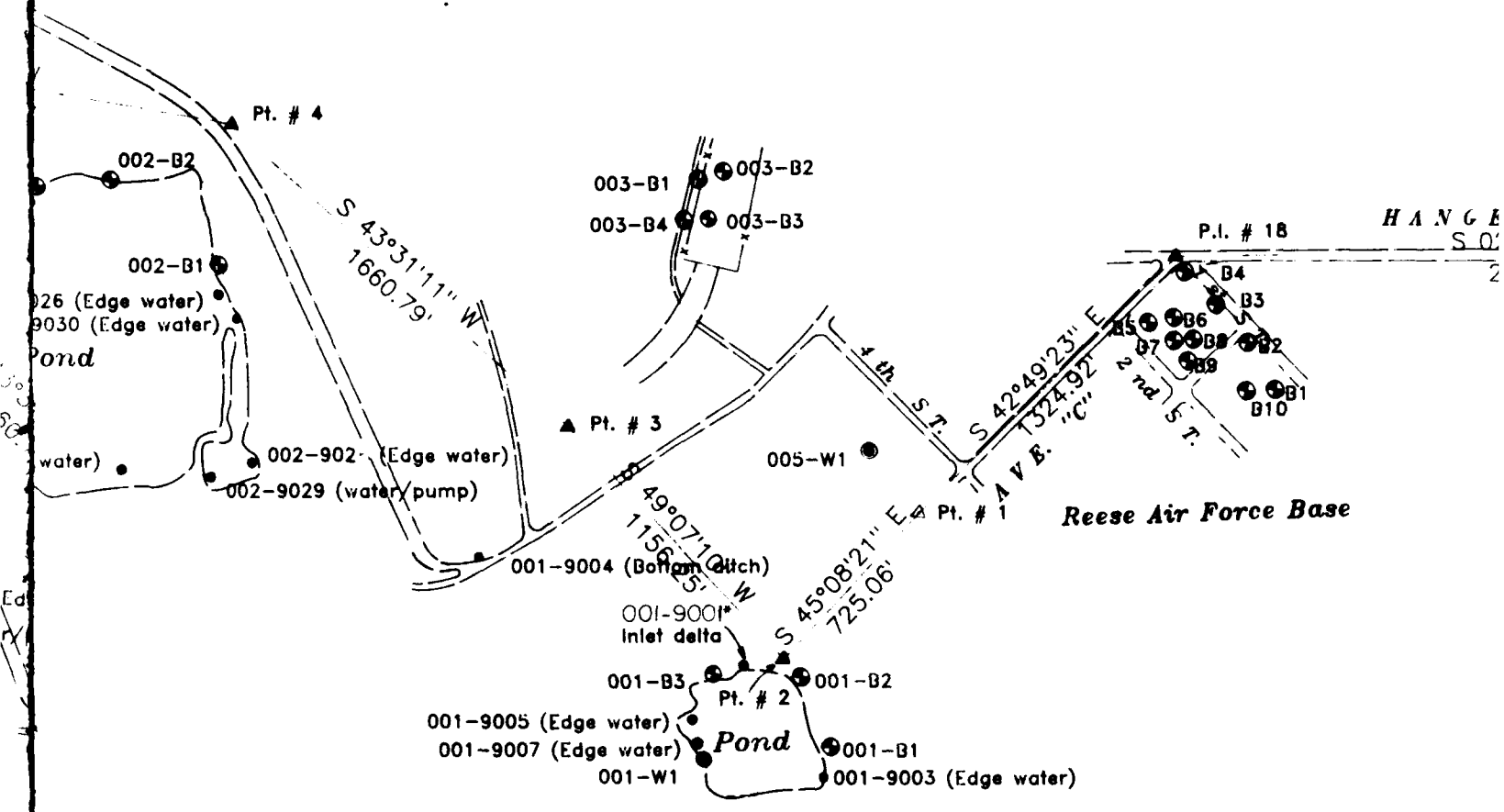
PLAT SHOWING
rings, and water sample points on
Reese Air Force Base
ubbock County, Texas

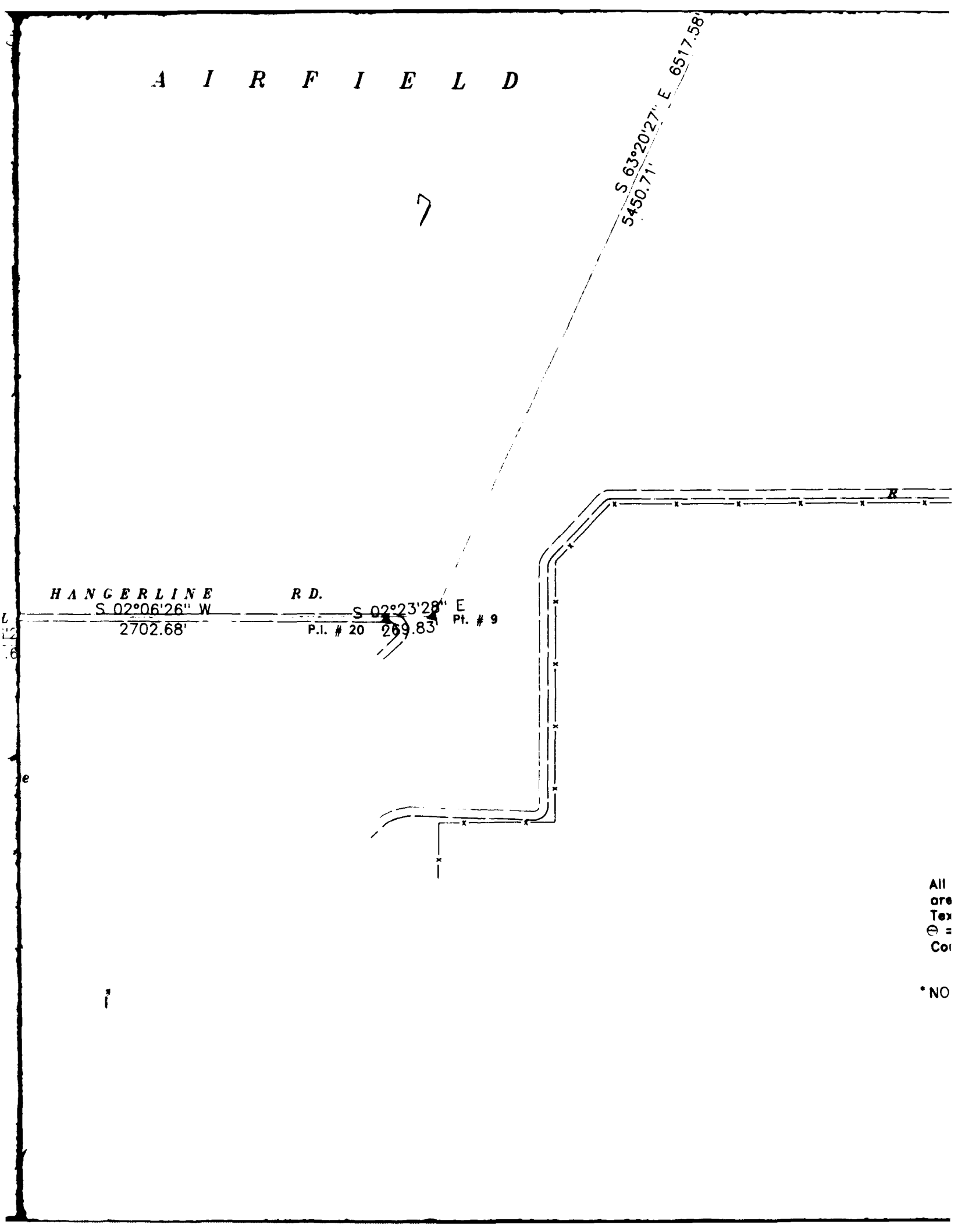


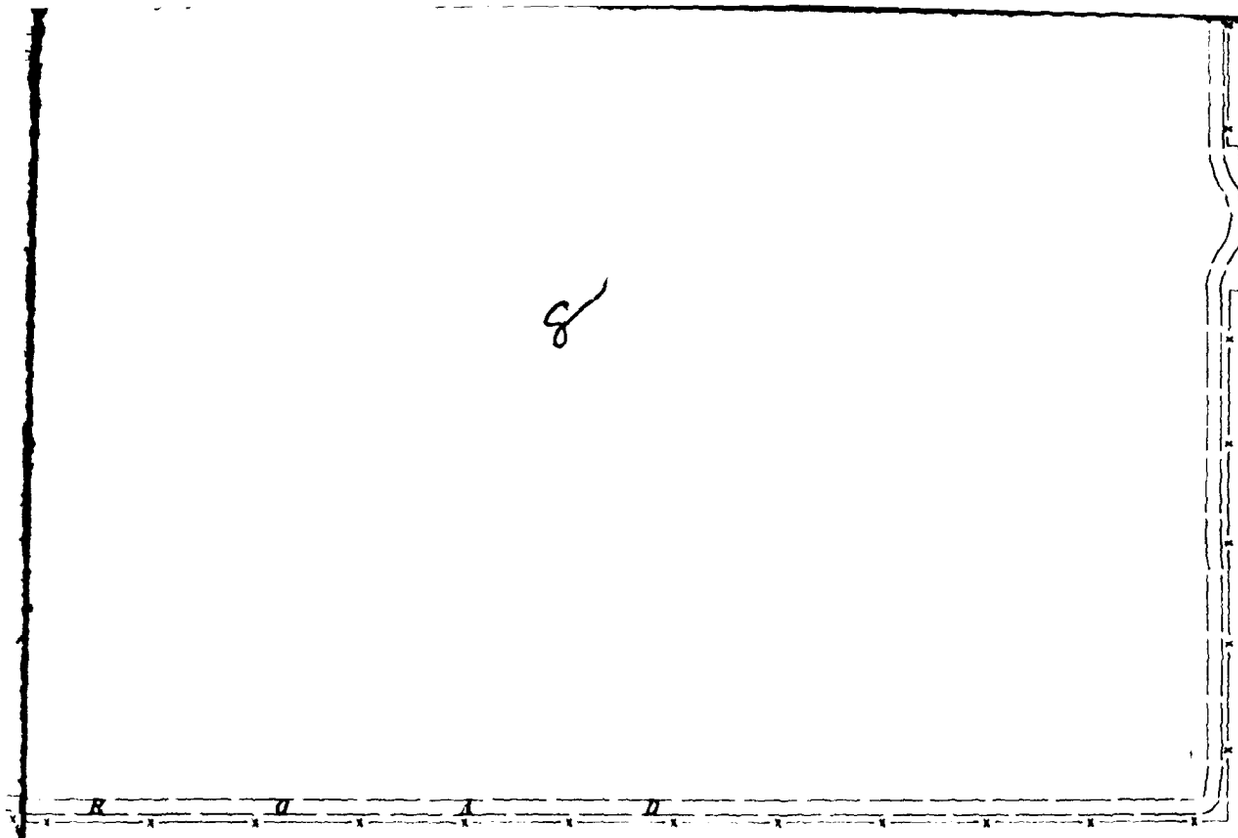


Description	Northing	Easting	Elevation
B1	730,236.922	620,685.239	3324.87
B2	730,141.744	620,509.794	3324.56
B3	730,030.513	620,366.233	3324.26
B4	729,919.110	620,241.863	3324.40
B5	729,780.544	620,421.988	3323.88
B6	729,874.423	620,406.448	3324.18
B7	729,872.224	620,490.846	3323.95
B8	729,943.639	620,488.893	3324.18
B9	729,922.055	620,566.936	3323.85
B10	730,131.306	620,685.211	3324.11
005-W1, top p.v.c. pipe	728,743.561	620,853.439	3318.67
001-9003	728,545.481	622,015.619	
001-B1	728,565.966	621,924.266	3300.14
001-B2	728,467.142	621,668.370	3300.29
001-9001*	728,402.658	621,634.843	
inlet delta	728,271.857	621,609.055	
001-B3	728,147.839	621,642.354	3299.38
001-9005	728,074.232	621,791.823	
001-9007	728,099.376	621,932.508	
001-W1, top p.v.c. pipe	728,100.817	621,951.571	3301.64
003-B1	728,156.535	619,841.907	3328.67
003-B2	728,249.757	619,817.473	3327.06
003-B3	728,187.347	619,987.302	3326.97
003-B4	728,099.689	619,988.880	3327.35
001-9004	727,311.771	621,176.311	
002-W1, top p.v.c. pipe	725,611.146	620,920.314	3296.74
002-9027	725,998.804	620,818.571	
002-9029	726,331.489	620,850.210	
002-9025	726,486.617	620,807.312	
002-9030	726,440.737	620,280.736	
002-9026	726,371.081	620,196.406	
002-B1	726,375.676	620,092.020	3298.52


ROAD
008-W4
008-W5
Pt. # 6
ROAD
ROAD
008-W1
N 69°44'12" W
2350.89'
008-W2
008-B2
Pt. # 5
008-B1
008-W3
S 11°49'22" W
2134.97'
H.
S.
Pt. #
002-B3
002-B2
002-B1
002-9026 (Edge water)
002-9030 (Edge water)
Pond
002-9027 (in water)
002-9
002-W1
002-9029


Pt. # 4
002-B2
002-B1
026 (Edge water)
9030 (Edge water)
Pond
water)
002-902 (Edge water)
002-9029 (water/pump)
S 43°31'11" W
1660.79'
003-B1
003-B2
003-B4
003-B3
Pt. # 3
005-W1
4th S.T.
S 42°49'23" E
1524.92'
"C" AVE.
P.I. # 18
B4
B3
B5
B6
B7
B8
B2
B9
B1
B10
2nd S.T.
Pt. # 1
Reese Air Force Base
001-9004 (Bottom ditch)
49°07'10" W
1156.25'
001-9001*
Inlet delta
S 45°08'21" E
725.06'
001-B3
Pt. # 2
001-B2
001-9005 (Edge water)
001-9007 (Edge water)
Pond
001-B1
001-W1
001-9003 (Edge water)


AIRFIELD
7
S 63°20'27" E 6517.58'
5450.71'
R
HANGERLINE RD.
S 02°06'26" W
2702.68'
P.I. # 20
S 02°23'28" E
269.83'
Pt. # 9

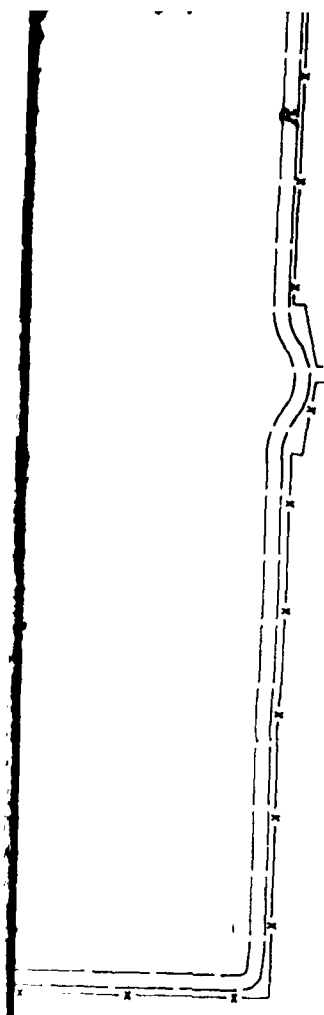


Scale : 1" = 600'
October 7, 1986
● = Water wells
● = Borings
• = Water & sediment sample points

All coordinates, distances, and bearings are in accordance to the Lambert Grid Texas North Central Zone.
$\ominus$ = -2°28'19"
Combined scale factor = 0.999873952

*NOTE: Point designated 001-9001 (Edge water) is not a sample location. 001-9001 is the designation for the inlet delta location.

CERTIFIED CORRECT: Ga
Registere

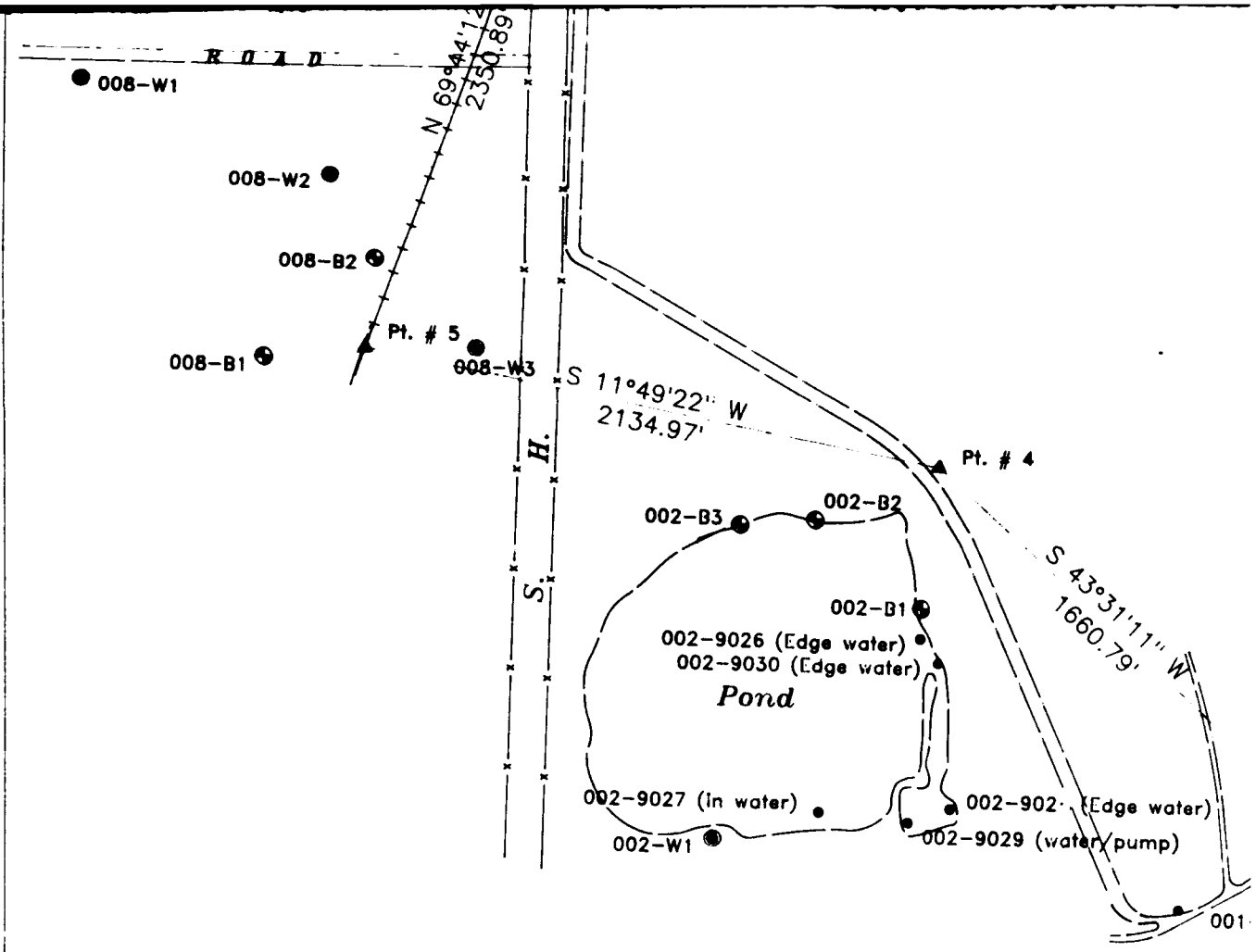


003-B3	728,187.347	619,987.302	3326.97
003-B4	728,099.689	619,988.880	3327.35
001-9004	727,311.771	621,176.311	
002-W1, top p.v.c. pipe	725,611.146	620,920.314	3296.74
002-9027	725,998.804	620,818.571	
002-9029	726,331.489	620,850.210	
002-9025	726,486.617	620,807.312	
002-9030	726,440.737	620,280.736	
002-9026	726,371.081	620,196.406	
002-B1	726,375.676	620,092.020	3298.52
002-B2	725,989.803	619,768.337	3294.08
002-B3	725,716.965	619,783.063	3293.76
008-W1, top conc. base	723,330.920	618,134.794	3316.88
008-W2, top well slab	724,230.482	618,496.092	3315.12
008-W3, top conc. base	724,755.690	619,146.289	3311.20
008-W4, top well slab	724,714.761	616,741.089	3318.13
008-W5, top well slab	725,075.491	616,770.738	3318.86
008-B1	723,988.712	619,174.953	3306.50
008-B2	724,389.963	618,818.577	3313.34
004-W1, top p.v.c. pipe	727,320.688	612,871.296	3338.64
004-B1	728,019.453	612,744.448	3331.49
004-B2	728,194.756	613,362.330	3330.12
004-B3	727,782.652	613,731.066	3331.72
006-B1	728,453.344	614,827.123	3311.74
006-B2	728,701.437	614,474.615	3310.91
006-9047	728,731.570	614,942.939	
006-9048	728,727.707	615,045.640	
007-B1	739,381.027	614,713.635	3329.16
007-B2	739,390.990	614,581.297	3329.64
007-B3	738,889.204	614,704.167	3332.27
007-B4	739,032.859	614,557.788	3331.64
Pt. # 1	728,917.995	621,085.301	
Pt. # 2	728,406.550	621,599.235	
Pt. # 3	727,649.799	620,725.020	
Pt. # 4	726,445.497	619,581.392	3304.56
Pt. # 5	724,355.817	619,143.970	3312.95
Pt. # 6	725,170.013	616,938.572	
Pt. # 7	727,694.876	612,802.053	
Pt. # 8	735,784.536	614,448.125	
Pt. # 9	732,860.203	620,272.823	
Pt. # 10	727,971.254	613,669.299	
Pt. # 11	738,340.497	614,649.734	3334.97
Pt. # 12	735,305.849	615,401.576	
P.I. # 18, Monument	729,889.763	620,184.708	3324.37
P.I. # 20, Monument	732,590.610	620,284.080	3330.46

CERTIFIED CORRECT: Gary D Wilson

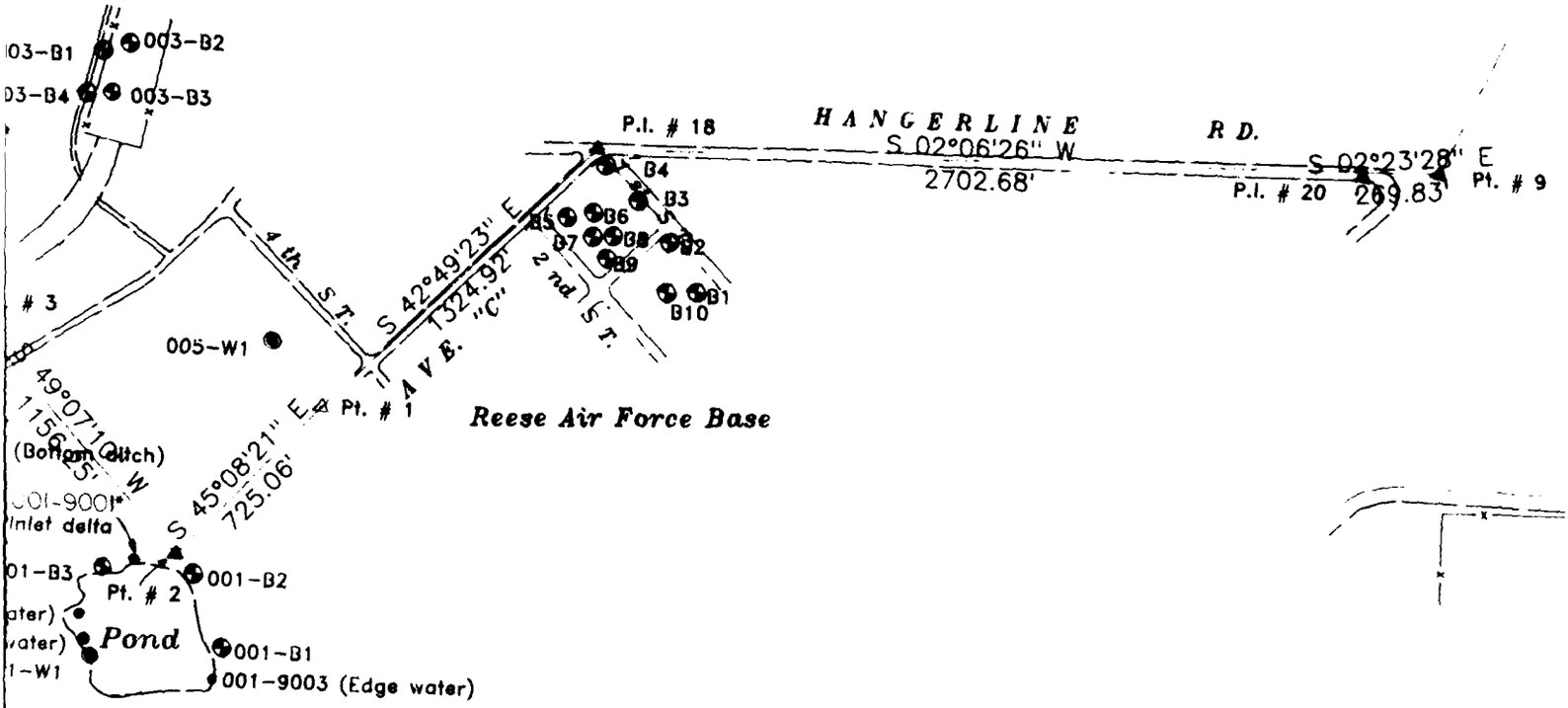
Gary D. Wilson
Registered Public Surveyor

STATE OF TEXAS
GARY D WILSON
4239
REGISTERED PUBLIC SURVEYOR

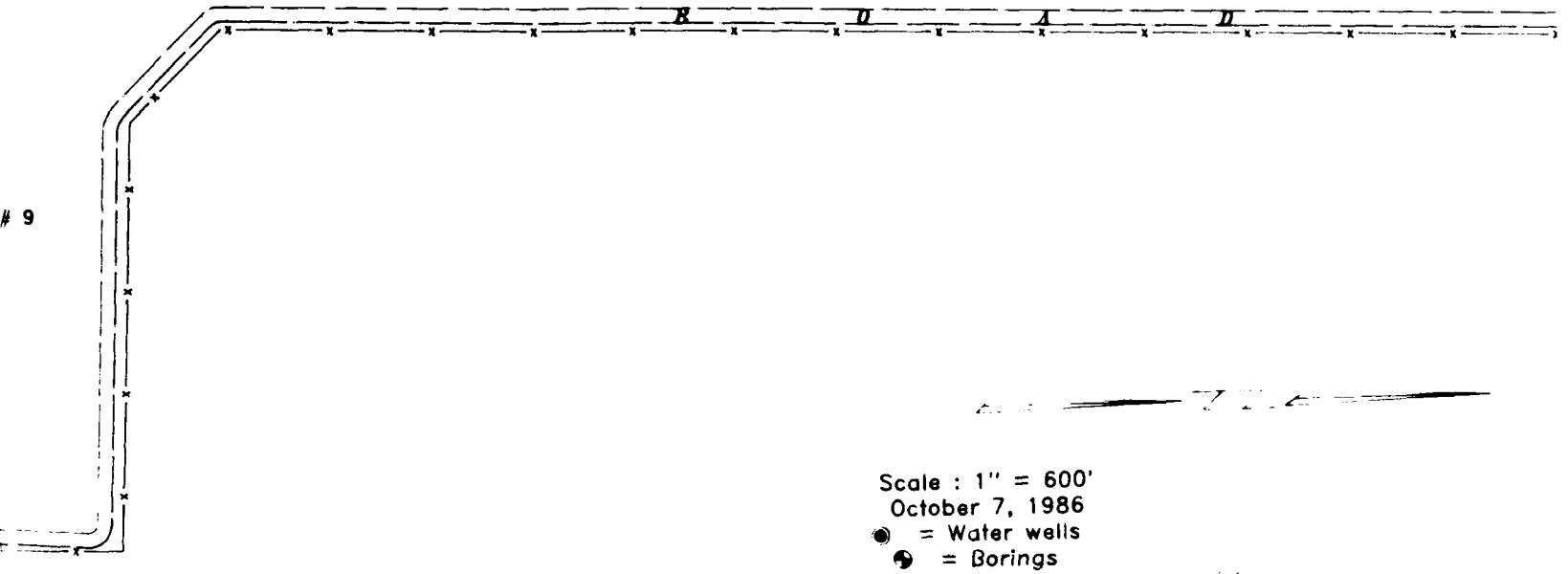

R O A D
008-W1
N 69°44'12" E
2350.89'
008-W2
008-B2
Pt. # 5
008-B1
008-W3
S. H.
S 11°49'22" W
2134.97'
Pt. # 4
002-B3
002-B2
002-B1
S 43°31'11" W
1660.79'
002-9026 (Edge water)
002-9030 (Edge water)
Pond
002-9027 (in water)
002-902· (Edge water)
002-W1
002-9029 (water/pump)
001-9005 (E
001-9007 (

1

10



WILSON SURVI
(806) 763-3388 * 1718 AVEN

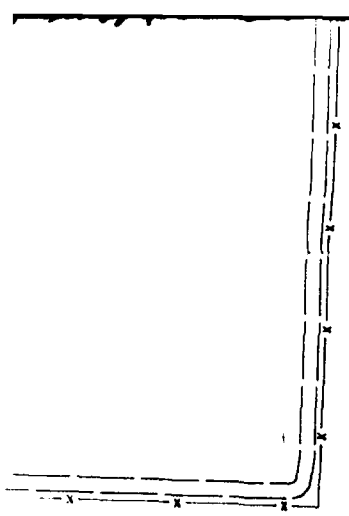


Scale : 1" = 600'
October 7, 1986
◉ = Water wells
◔ = Borings
• = Water / sediment sample points

All coordinates, distances, and bearings are in accordance to the Lambert Grid Texas North Central Zone.
⊖ = −2°28'19"
Combined scale factor = 0.999873952

*NOTE: Point designated 001-9001 (Edge water) is not a sample location. 001-9001 is the designation for the inlet delta location.

EYING Co., INC.
ENUE "N" * LUBBOCK, TEXAS 79401



008-B1	[illegible]	[illegible]	[illegible]
008-B2	724,389.963	618,818.577	3313.34
004-W1, top p.v.c. pipe	727,320.688	612,871.296	3338.64
004-B1	728,019.453	612,744.448	3331.49
004-B2	728,194.756	613,362.330	3330.12
004-B3	727,782.652	613,731.066	3331.72
006-B1	728,453.344	614,827.123	3311.74
006-B2	728,701.437	614,474.615	3310.91
006-9047	728,731.570	614,942.939	
006-9048	728,727.707	615,045.640	
007-B1	739,381.027	614,713.635	3329.16
007-B2	739,390.990	614,581.297	3329.64
007-B3	738,889.204	614,704.167	3332.27
007-B4	739,032.859	614,557.788	3331.64
Pt. # 1	728,917.995	621,085.301	
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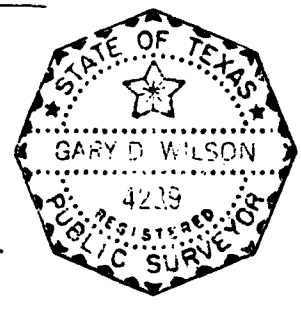
Pt. # 5	724,355.817	619,143.970	3312.95
Pt. # 6	725,170.013	616,938.572	
Pt. # 7	727,694.876	612,802.053	
Pt. # 8	735,784.536	614,448.125	
Pt. # 9	732,860.203	620,272.823	
Pt. # 10	727,971.254	613,669.299	
Pt. # 11	738,340.497	614,649.734	3334.97
Pt. # 12	735,305.849	615,401.576	
P.I. # 18, Monument	729,889.763	620,184.708	3324.37
P.I. # 20, Monument	732,590.610	620,284.080	3330.46

CERTIFIED CORRECT: Gary D Wilson

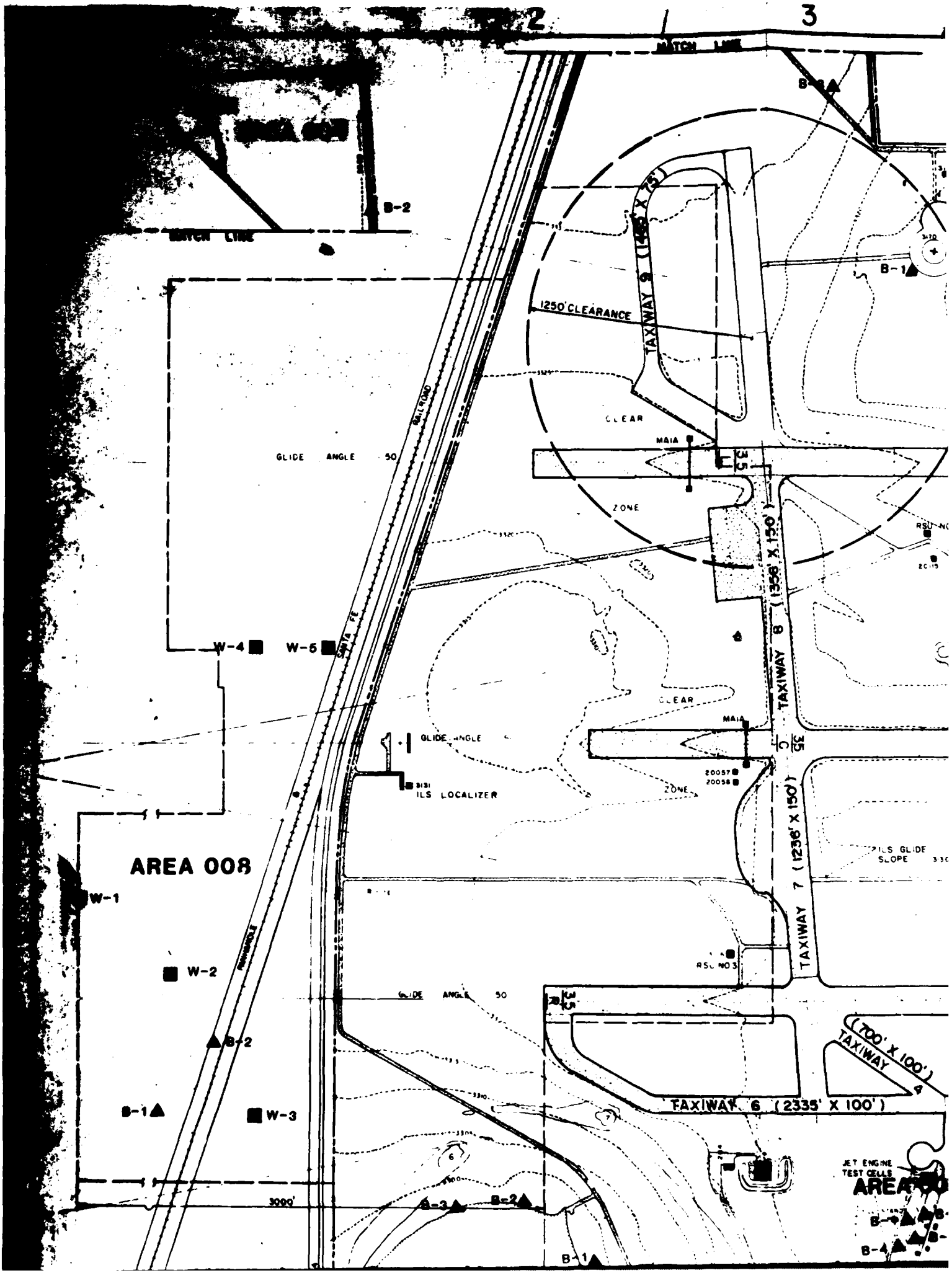
Gary D. Wilson
Registered Public Surveyor

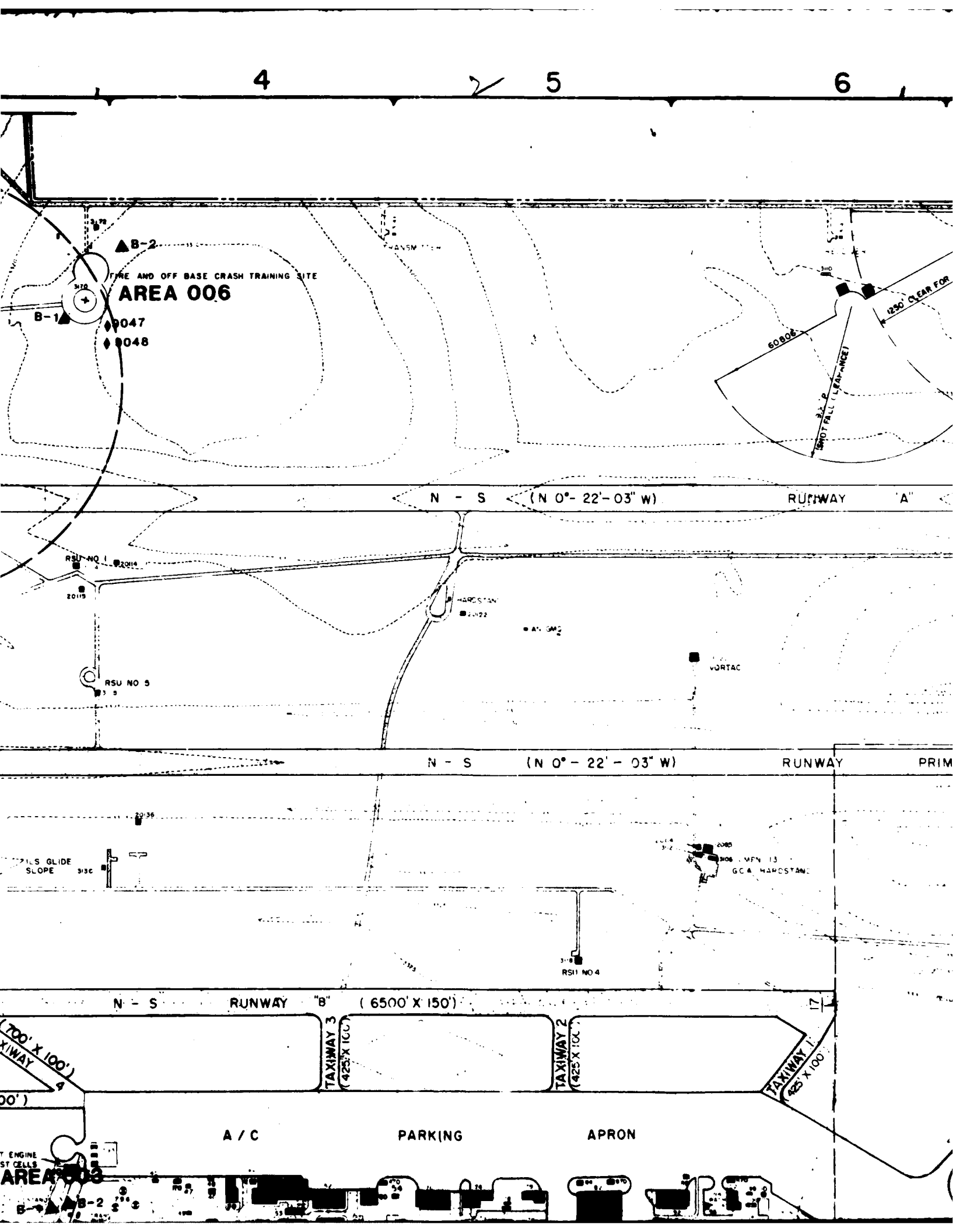


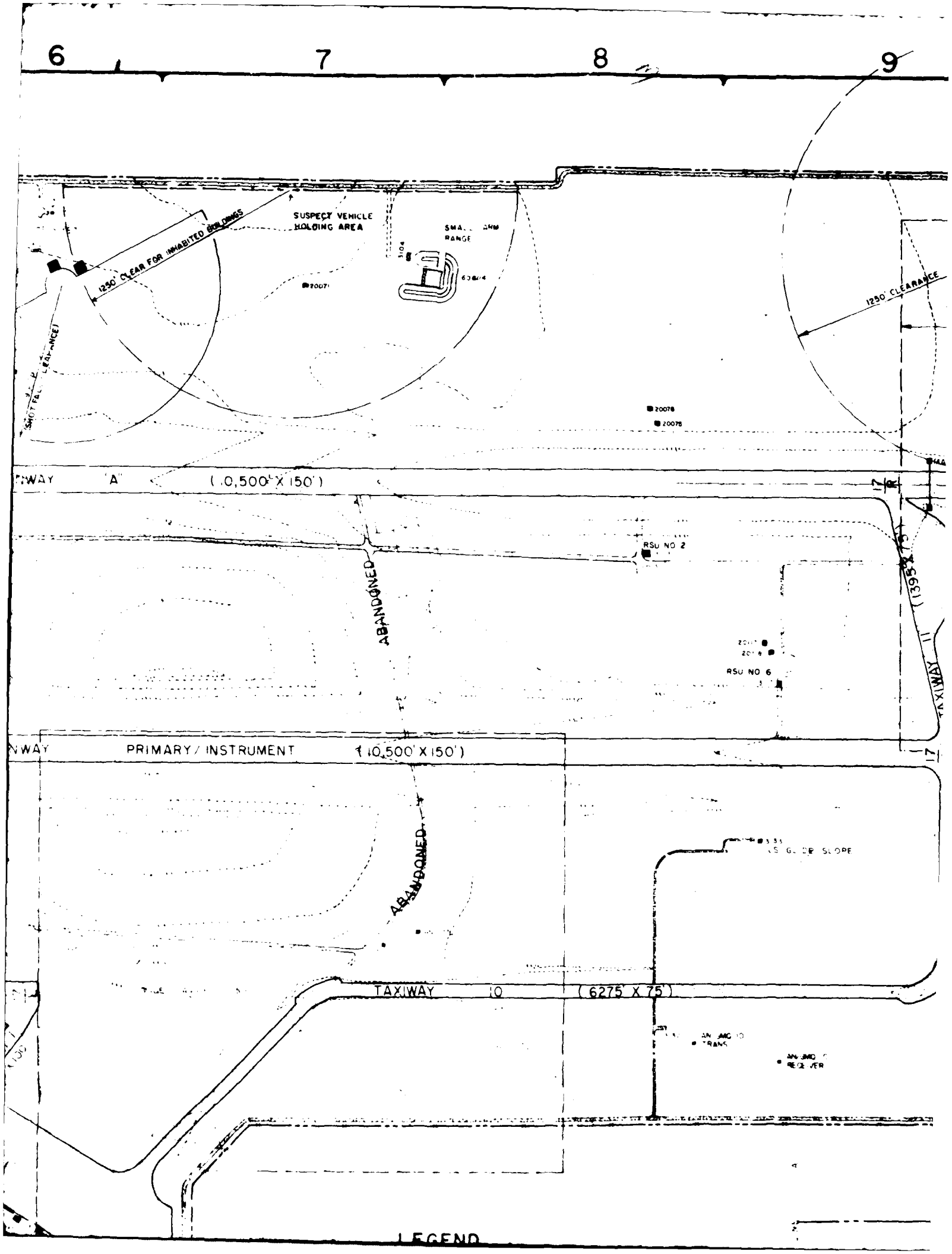
MAY 3 1988

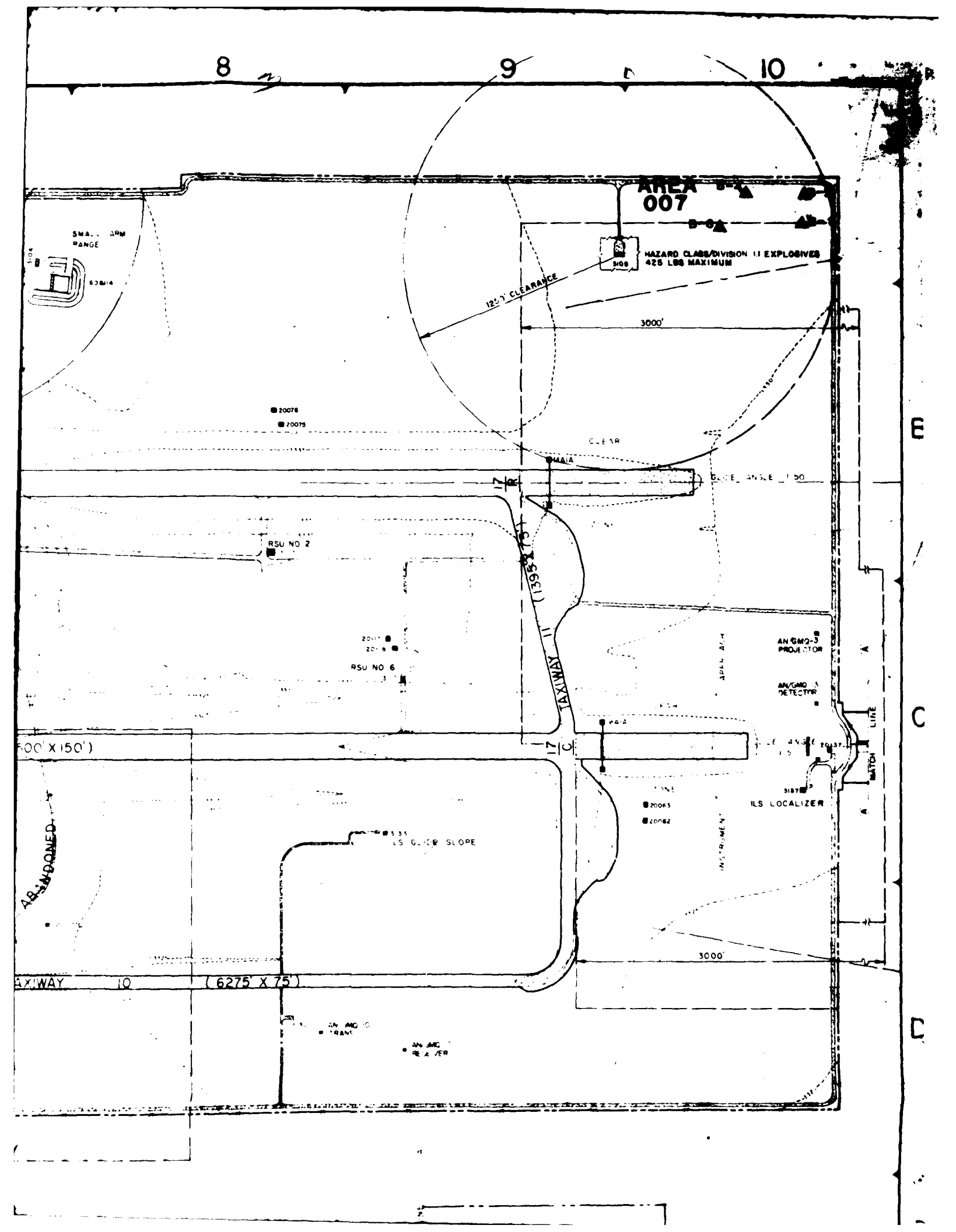
Figure 3–2

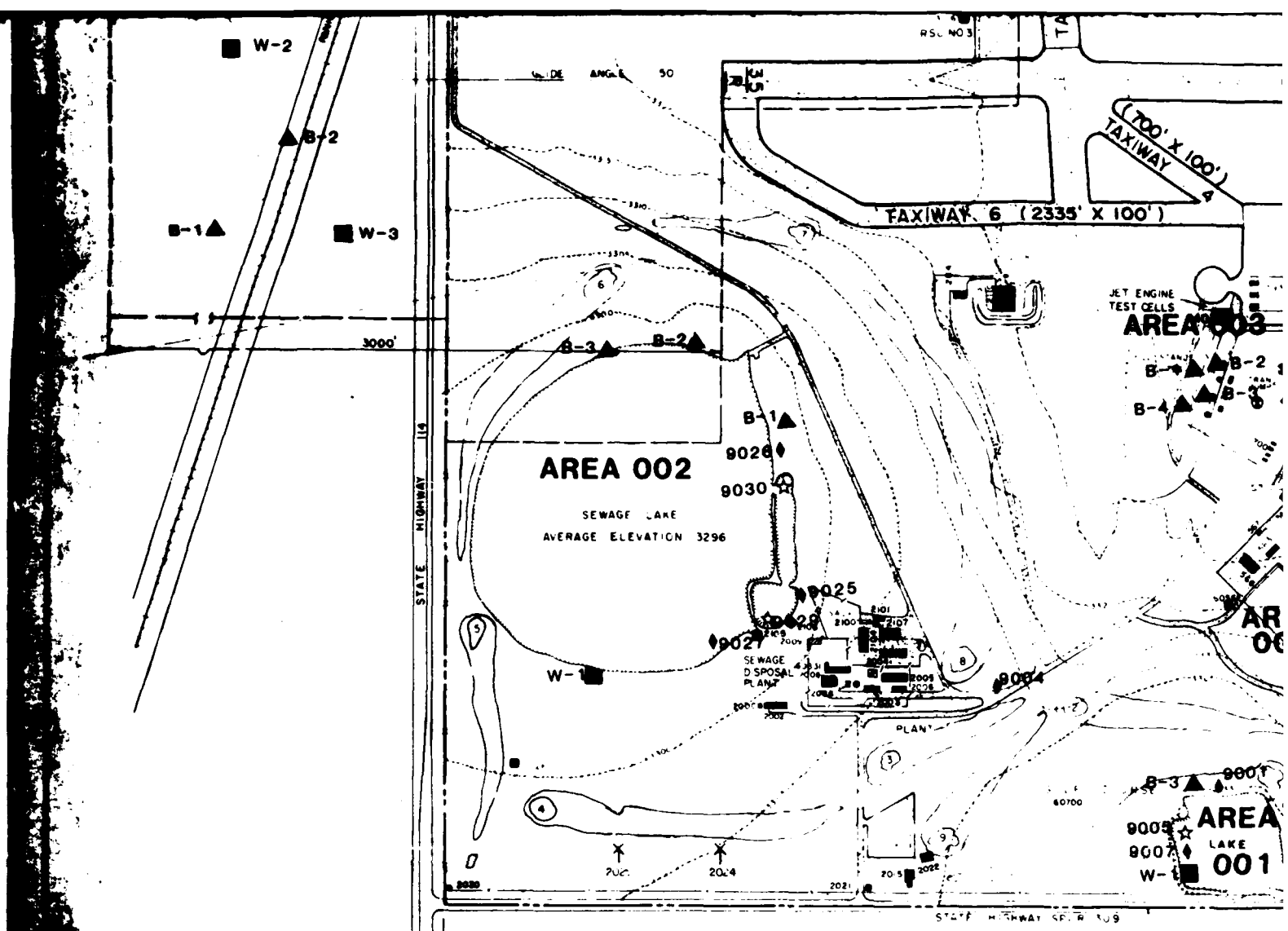
WATER WELLS, BORINGS, SAMPLE POINTS, AND ELEVATION DATA, REESE AFB


2
3
MATCH LINE
B-2
MATCH LINE
B-3
B-1
1250' CLEARANCE
TAXIWAY 8 (1358' X 150')
CLEAR
MAIA
ZONE
GLIDE ANGLE 50
RAILROAD
SANTA FE
W-4
W-5
GLIDE ANGLE
ILS LOCALIZER
20057
20058
AREA 008
W-1
W-2
RSU NO 5
TAXIWAY 7 (1238' X 150')
ILS GLIDE SLOPE
GLIDE ANGLE 50
B-2
(700' X 100')
TAXIWAY
TAXIWAY 6 (2335' X 100')
B-1
W-3
JET ENGINE TEST CELLS
AREA
3000'
B-3
B-2
B-1
B-4


4
5
6
B-2
FIRE AND OFF BASE CRASH TRAINING SITE
AREA 006
B-1
0047
0048
1250' CLEAR FOR
60806
SHOT FALL (CLEARANCE)
N - S (N 0°- 22'-03" W) RUNWAY "A"
RSU NO 1
20116
20119
HARDSTAND
RSU NO 5
VORTAC
N - S (N 0° - 22' - 03" W) RUNWAY PRIM
20136
ILS GLIDE SLOPE
3130
GCA HARDSTAND
RSU NO 4
N - S RUNWAY "B" (6500' X 150')
700' X 100'
TAXIWAY 3
(425' X 100')
TAXIWAY 2
(425' X 100')
TAXIWAY 1
(425' X 100')
A / C
PARKING
APRON
AREA 003
B-2


6
7
8
9
SUSPECT VEHICLE HOLDING AREA
1250' CLEAR FOR INHABITED BUILDINGS
1250' CLEARANCE
RSU NO 2
RSU NO 6
ABANDONED
ABANDONED
PRIMARY / INSTRUMENT (10,500' X 150')
TAXIWAY 10 (6275' X 75')
LEGEND


8
9
10
E
C
C
AREA
007
HAZARD CLASS/DIVISION 1.1 EXPLOSIVES
425 LBS MAXIMUM
3100
12500' CLEARANCE
3000'
SMALL ARM
RANGE
20078
20075
CLEAR
MALA
GLIDE ANGLE 3.00
RSU NO 2
RSU NO 6
TAXIWAY 11 (1395' X 75')
AN/GMQ-3
PROJECTOR
AN/GMQ-3
DETECTOR
APRON AREA
17
C
(500' X 150')
ABANDONED
ILS GLIDE SLOPE
20065
20062
ILS LOCALIZER
INSTRUMENT
LINE
MATCH
3000'
TAXIWAY 10 (6275' X 75')
AN/GMQ-10
TRANSMITTER
AN/GMQ-10
RECEIVER

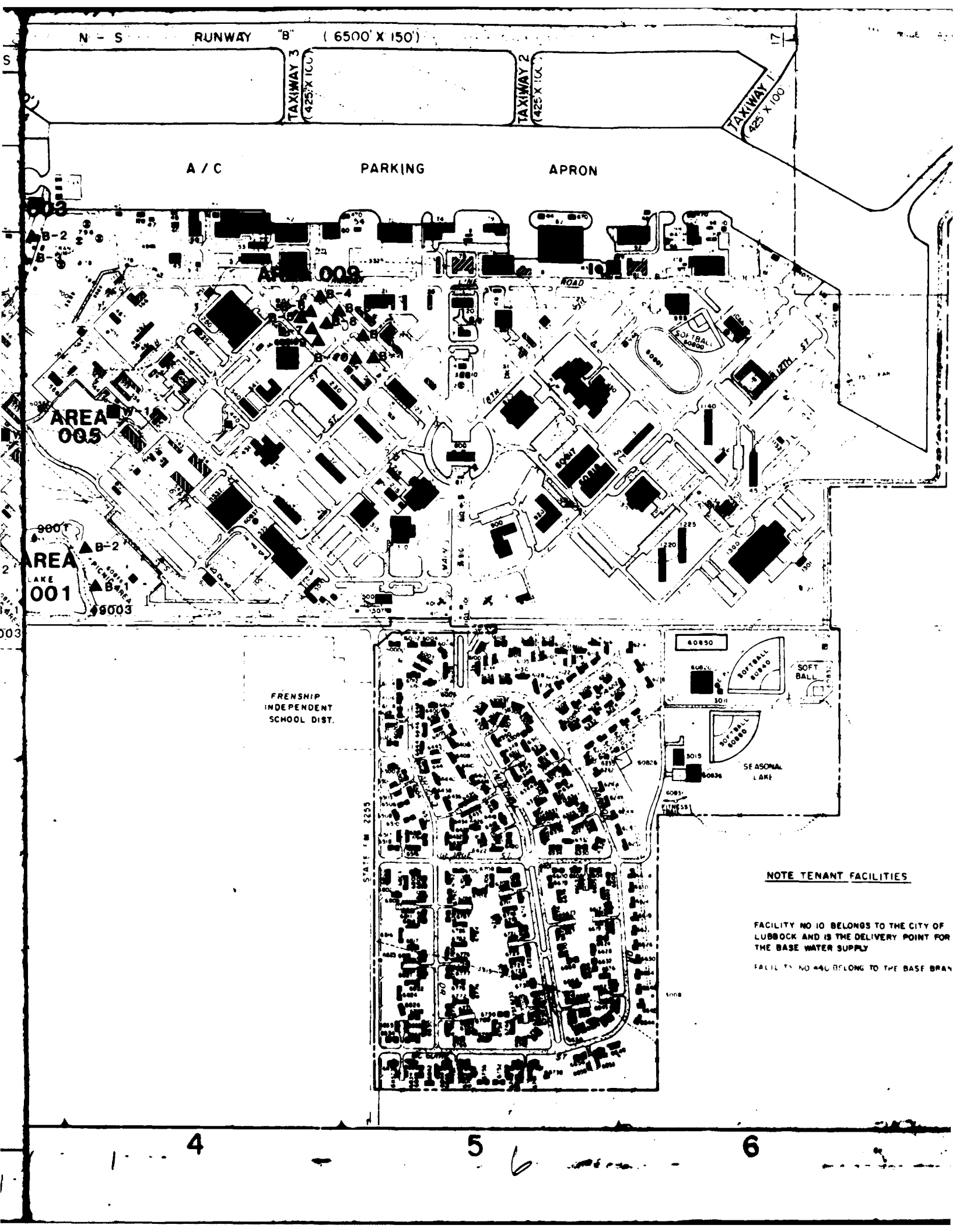


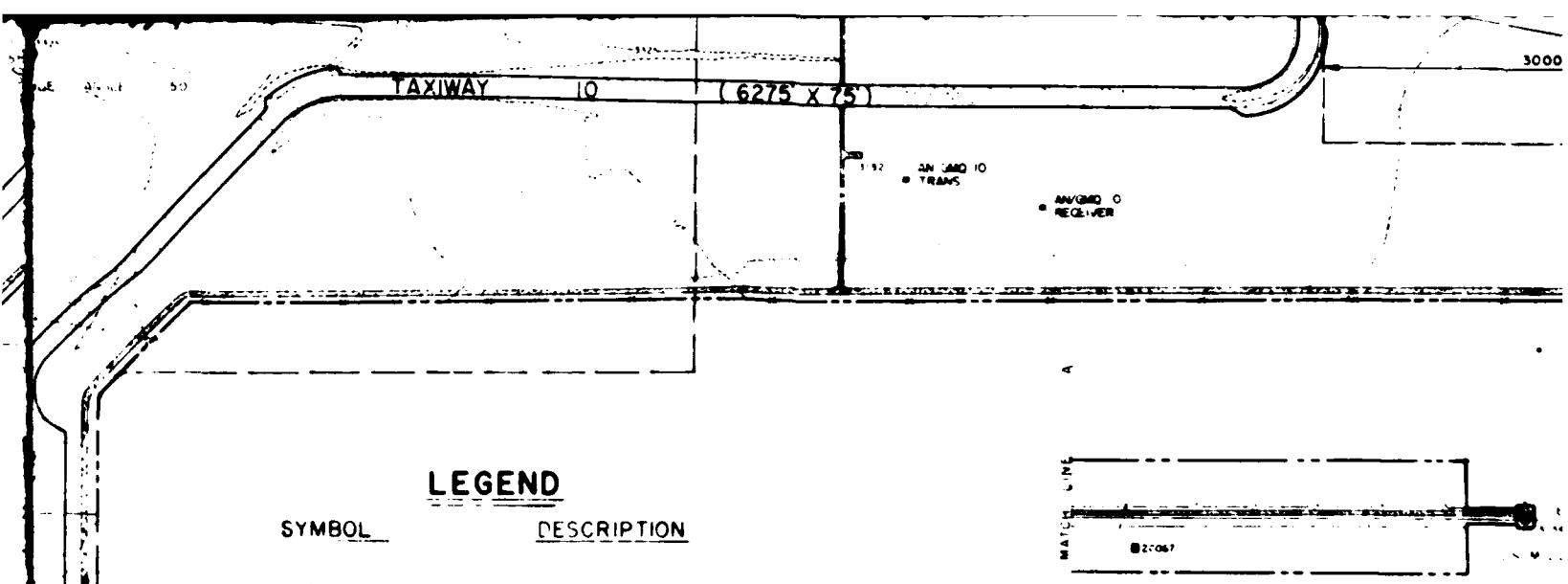
☆ Surface Water Samples

♦ Sediment Samples

▲ Borings

■ Wells


N - S RUNWAY "B" (6500' X 150')
TAXIWAY 3 (425' X 100')
TAXIWAY 2 (425' X 100')
TAXIWAY 1 (425' X 100')
A / C PARKING APRON
AREA 009
AREA 005
AREA 001
B-1
B-2
B-3
B-4
99003
FRENSHIP INDEPENDENT SCHOOL DIST.
SOFTBALL 60840
SOFT BALL
SOFTBALL 60860
SEASONAL LAKE
STATE FM 2255
NOTE TENANT FACILITIES
FACILITY NO 10 BELONGS TO THE CITY OF LUBBOCK AND IS THE DELIVERY POINT FOR THE BASE WATER SUPPLY
4
5
6



LEGEND

SYMBOL	DESCRIPTION
	EXISTING PERMANENT
	EXISTING SEMI PERMANENT
	EXISTING TEMPORARY
	AIRFIELD PAVEMENT TO BE RETAINED
	AIRFIELD PAVEMENT TO BE ABANDONED
	STREET PAVEMENT
	UNSURFACED ROADS
	FENCE - UNCLASSIFIED
	FENCE - CHAIN LINK
	CONTOUR LINE
	RAILROAD
	EXISTING BOUNDARY

Figur
AREAS INVE

FOR OFFICIAL

MAY 4 1988

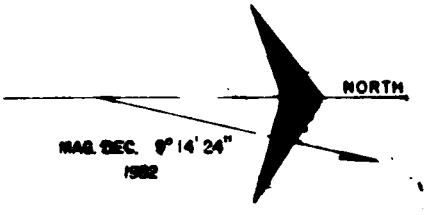
VAR	GENERAL REVISIONS
VAR	GENERAL REVISIONS
VAR	GENERAL REVISIONS
VAR	GENERAL REVISIONS
ZONE	DESCRIPTION

REVISIONS

APPROVED BY:
CHAIRMAN, BASE

CITY OF
OINT FOR

SE BRANCH JANK



SCALE 1" = 400'

ELEVATION 3000

DEPARTMENT OF
DIRECTORATE OF ENGINEERING AND SERVI

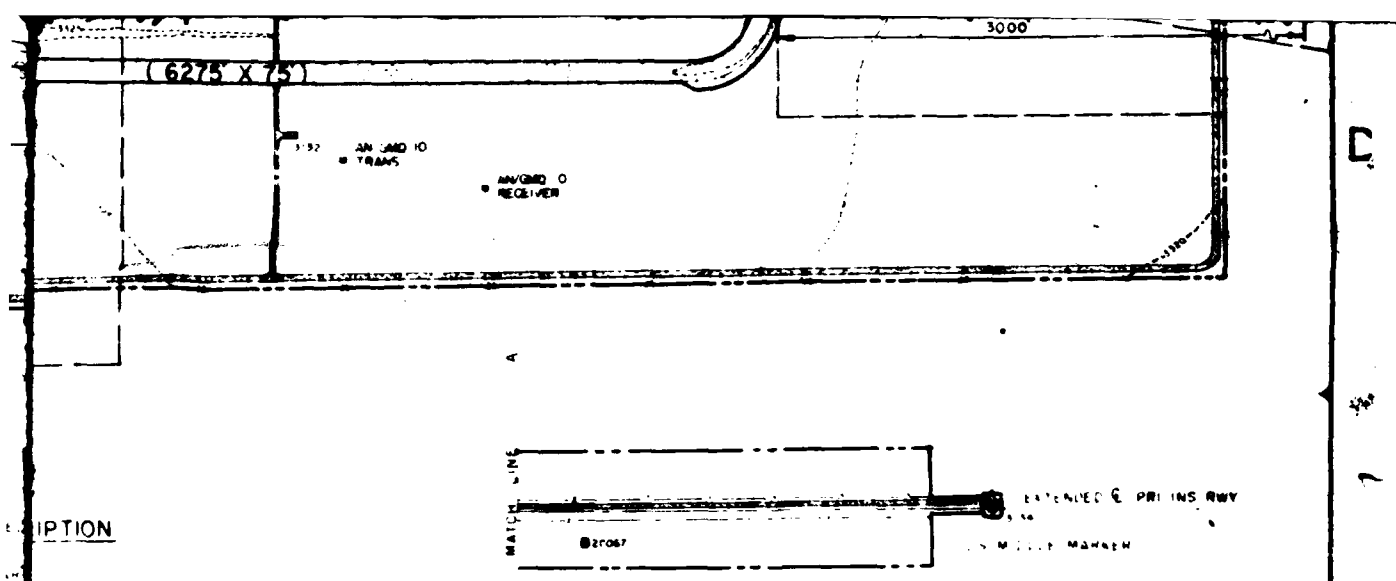
AIR TRAINING
BASE COMPREH
BASIC LAY
REESE
LUBBOCK

SCALE: 1 IN = 400 FT. DATE

DRAWN CHECKED DIRECTOR

LUBBOCK, TEXAS

CONTRACT NO



IPTION

MANENT
PERMANENT
PORARY

MENT TO BE RETAINED

MENT TO BE ABANDONED

MENT

ROADS

LASSIFIED

IN LINK

NE

UNDARY

Figure 4-1
AREAS INVESTIGATED

FOR OFFICIAL USE ONLY

MAY 4 1988

VAR	GENERAL REVISIONS	JOSEPHS	TBH
VAR	GENERAL REVISIONS	JOSEPHS	EG
VAR	GENERAL REVISIONS	OSTER	JSH
VAR	GENERAL REVISIONS	SOVERN	
ZONE	DESCRIPTION	DATE	APPROVED

REVISIONS

D BY:
REESE

NORTH
MAG SEC. 9°14'24"
1982

400 0 400 800

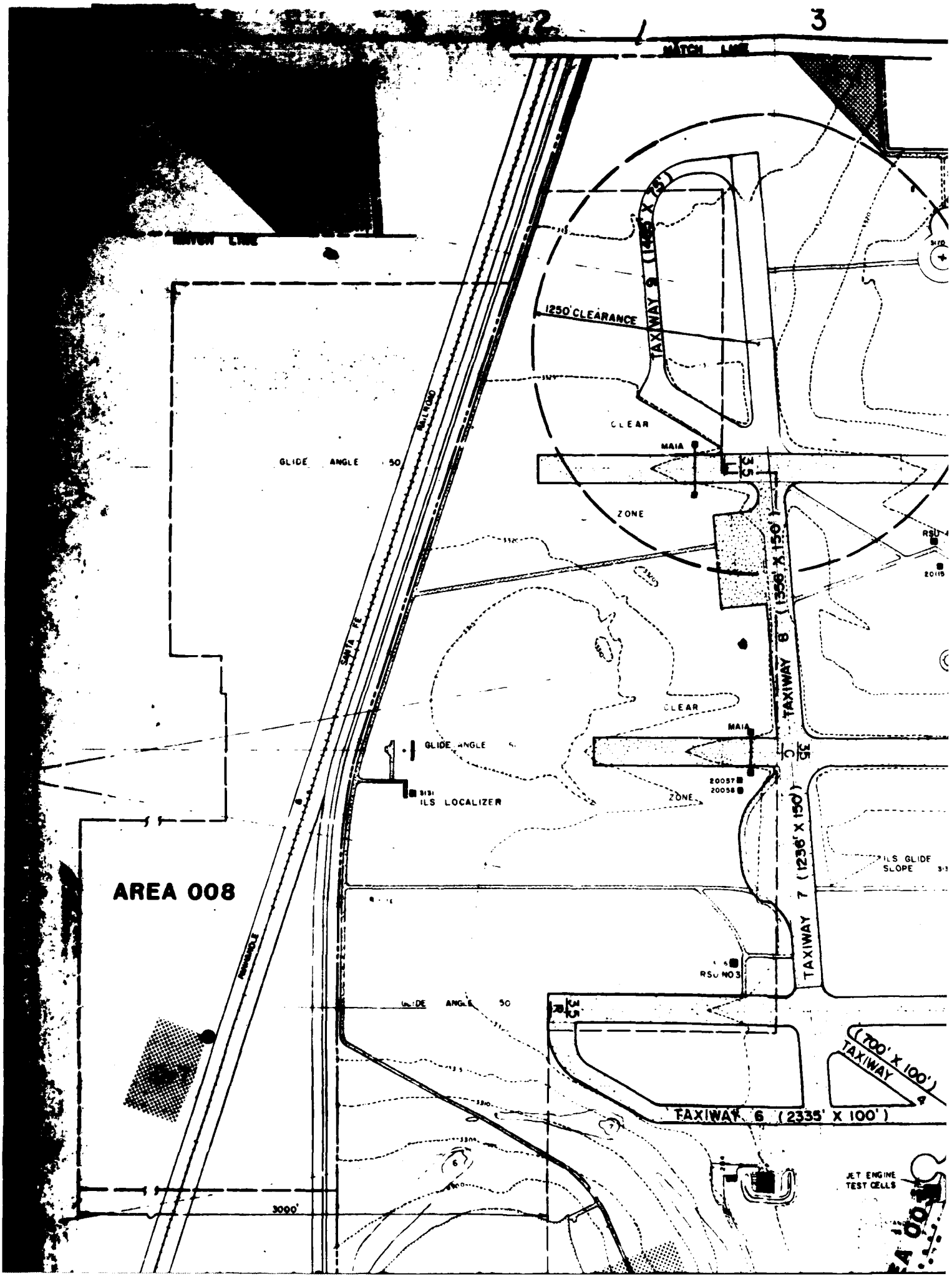
SCALE 1" = 400'

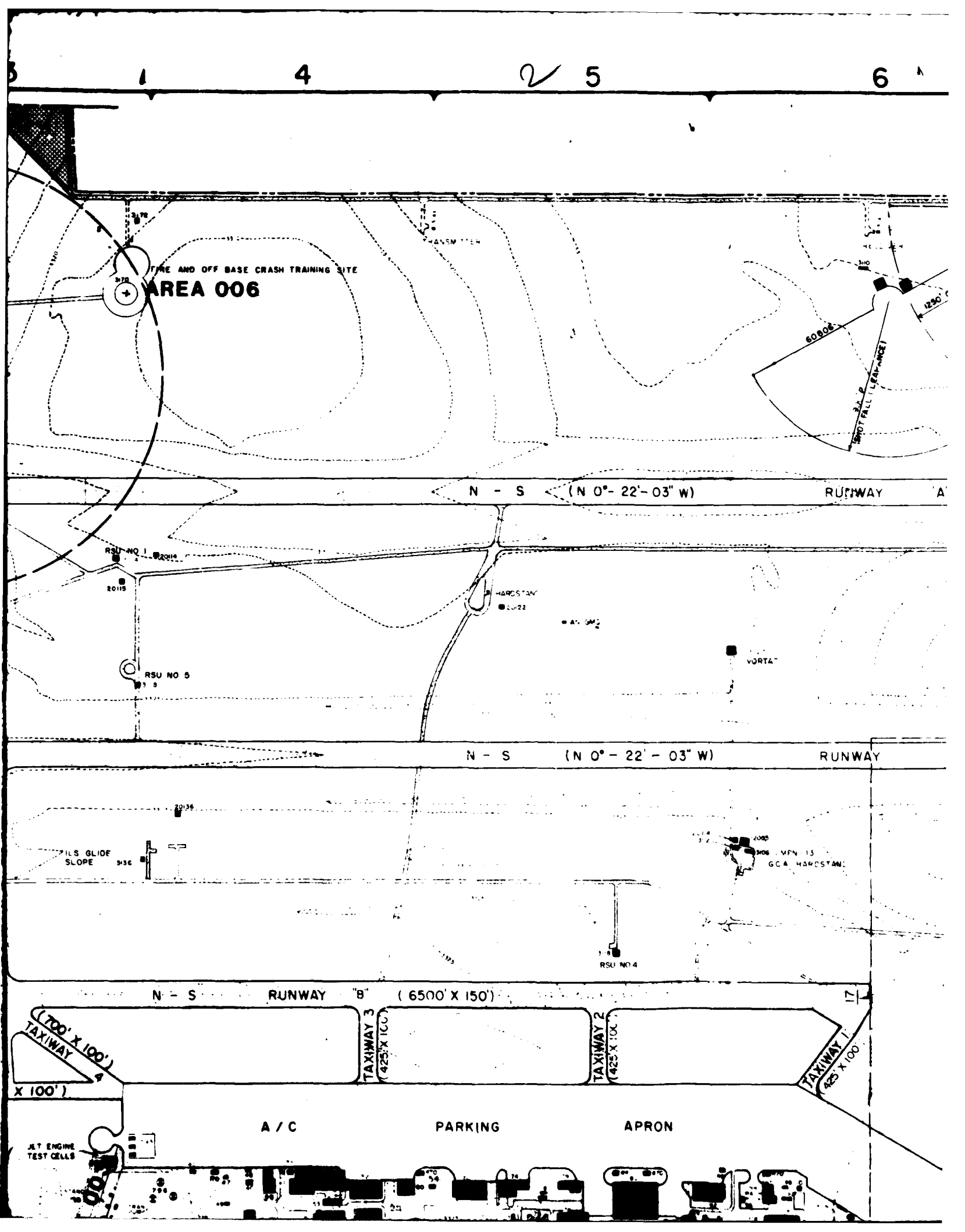
DEPARTMENT OF THE AIR FORCE
DIRECTORATE OF ENGINEERING AND SERVICES - USAF/LEE - WASHINGTON, DC

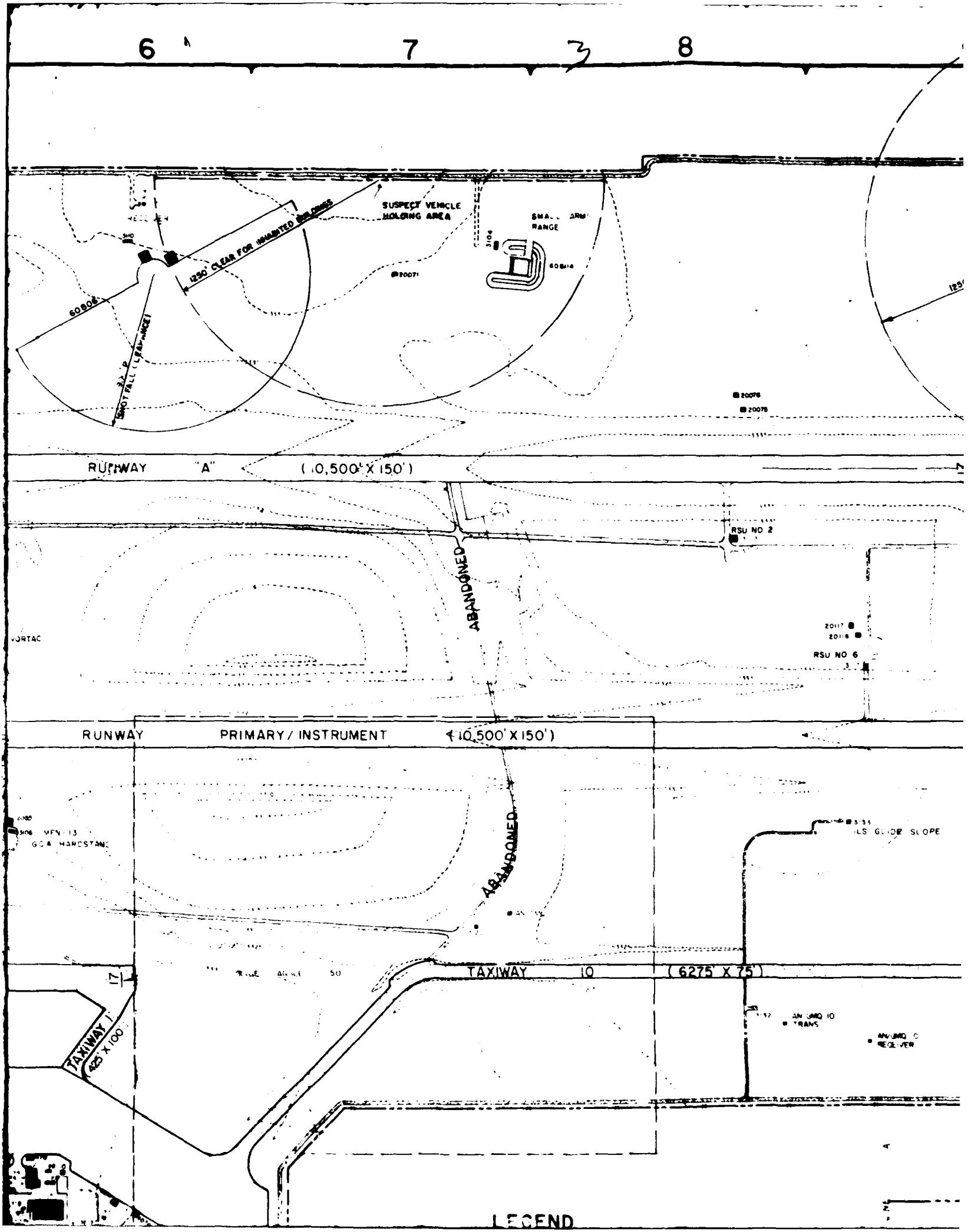
AIR TRAINING COMMAND
BASE COMPREHENSIVE PLAN
BASIC LAYOUT PLAN
REESE AIR FORCE BASE
LUBBOCK TEXAS

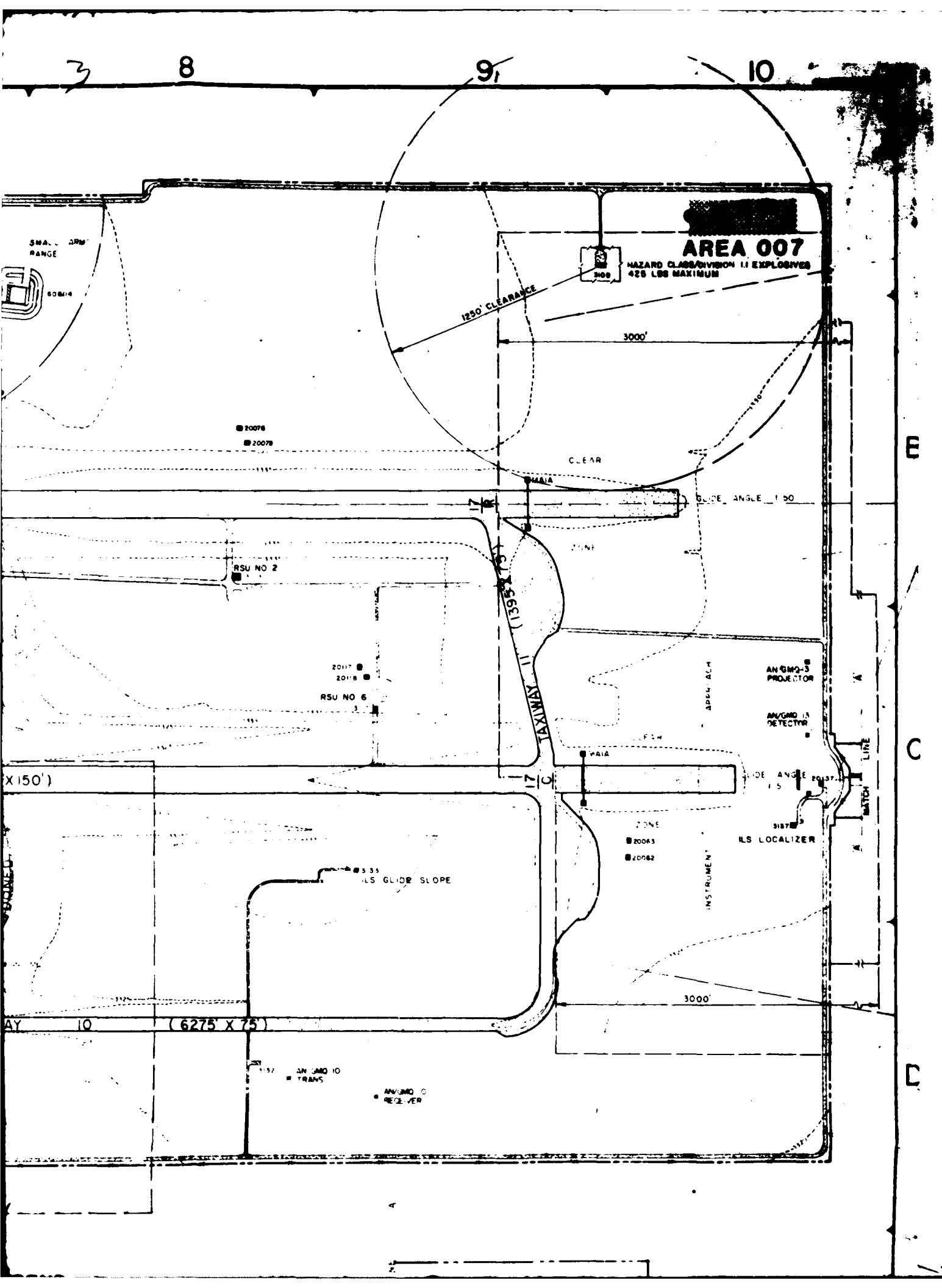
SCALE 1" = 400 FT. DATE 6 MAY 1988
DRAFTER DRAWING DIRECTIVE
LUBBOCK, TEXAS

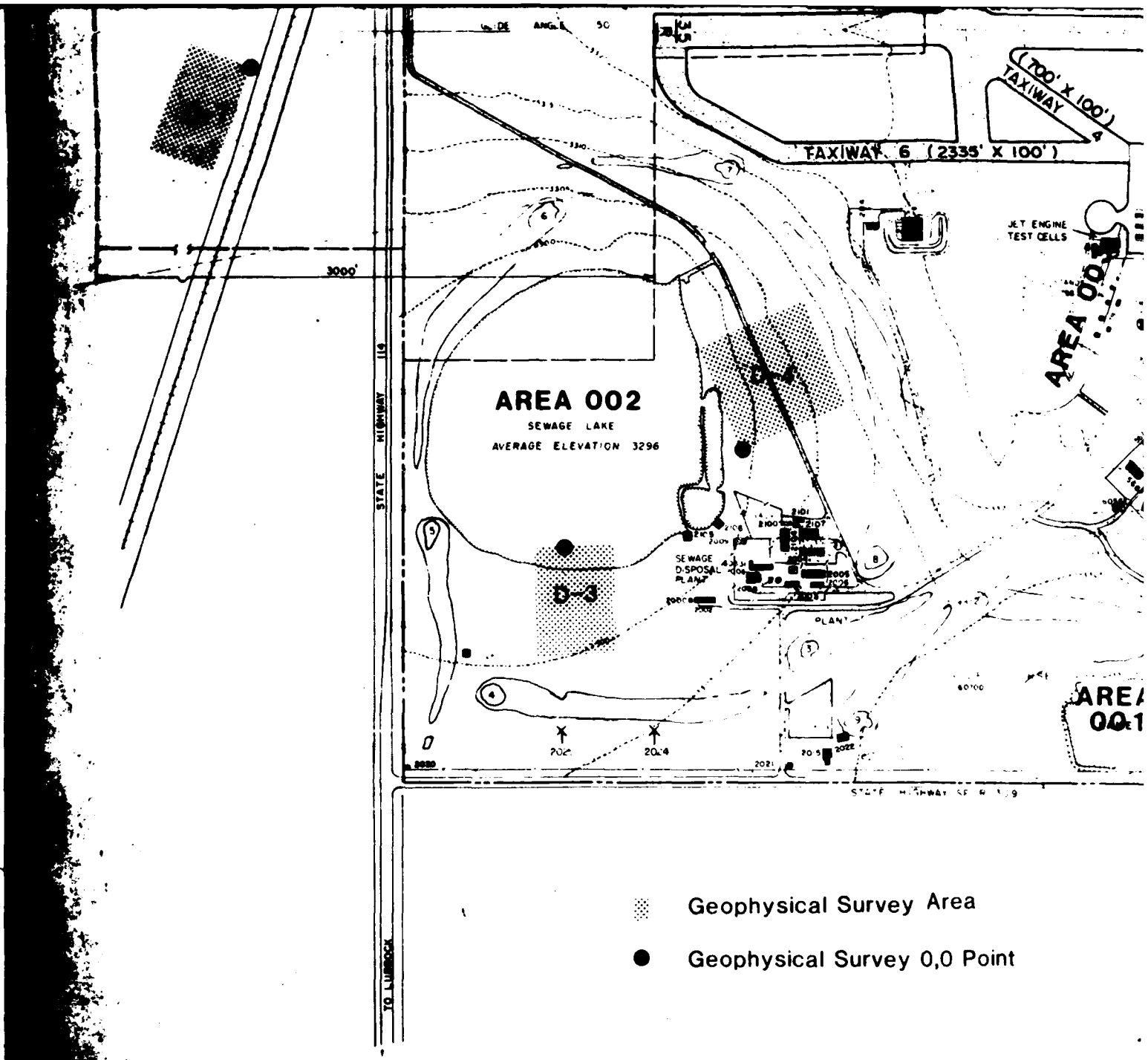
CONTRACT NO AF 41(657)-2

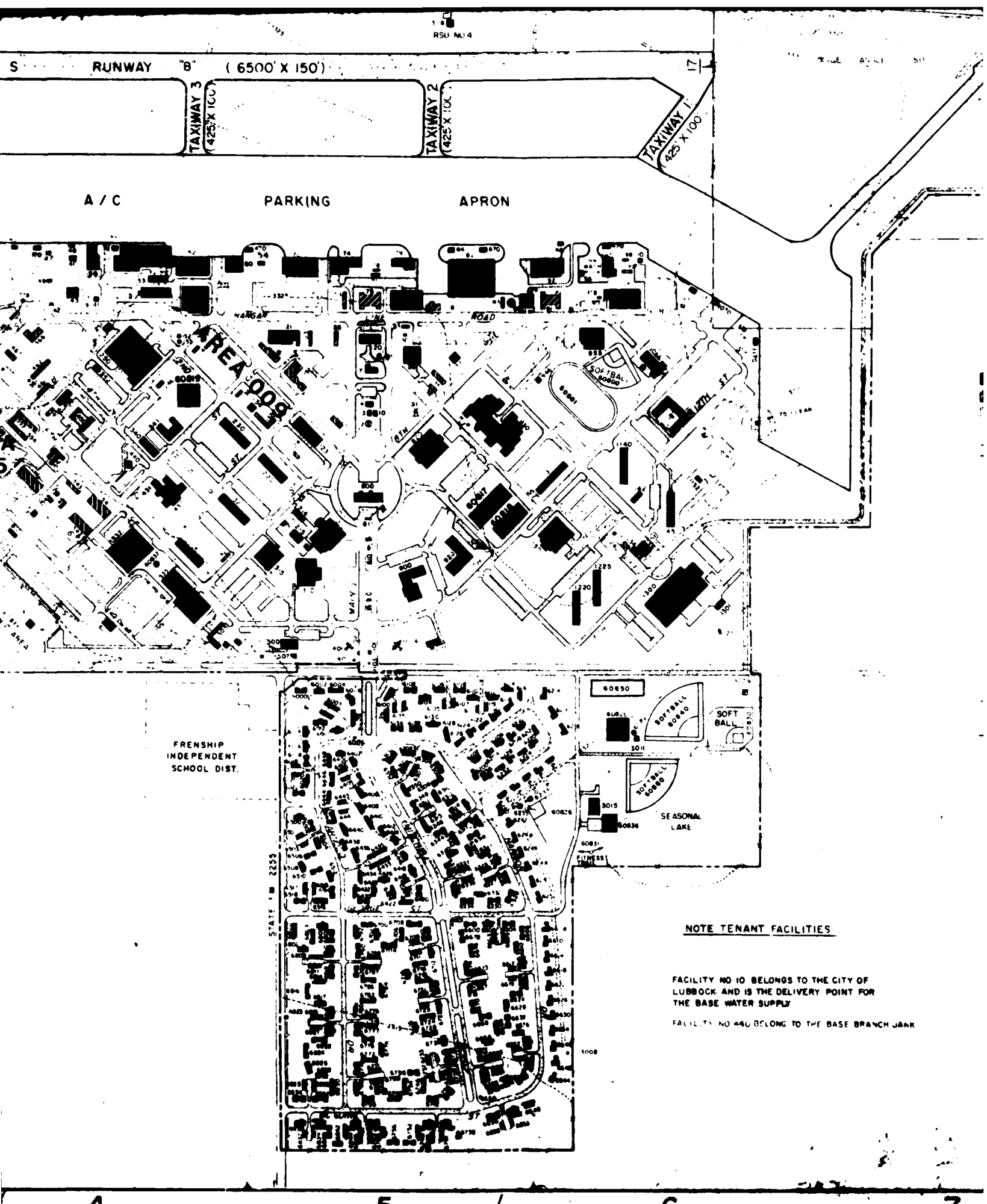

3
MATCH LINE
MATCH LINE
1250' CLEARANCE
TAXIWAY 9 (1446' X 75')
CLEAR
MAIA
GLIDE ANGLE 50
ZONE
SANTA FE RAILROAD
TAXIWAY 8 (1356' X 150')
RSU
20115
CLEAR
MAIA
GLIDE ANGLE
ILS LOCALIZER
20057
20058
ZONE
ILS GLIDE SLOPE
AREA 008
TAXIWAY 7 (1236' X 150')
RSU NO 3
RUNWAY
GLIDE ANGLE 50
(700' X 100')
TAXIWAY
TAXIWAY 6 (2335' X 100')
JET ENGINE TEST CELLS
3000'


FIRE AND OFF BASE CRASH TRAINING SITE
AREA 006
N - S (N 0°- 22'- 03" W) RUNWAY
RSU NO 1
RSU NO 5
VORTAC
N - S (N 0° - 22' - 03" W) RUNWAY
ILS GLIDE SLOPE
RSU NO 4
N - S RUNWAY "8" (6500' X 150')
TAXIWAY 3 (425' X 100')
TAXIWAY 2 (425' X 100')
TAXIWAY 1 (425' X 100')
A / C PARKING APRON
JET ENGINE TEST CELLS

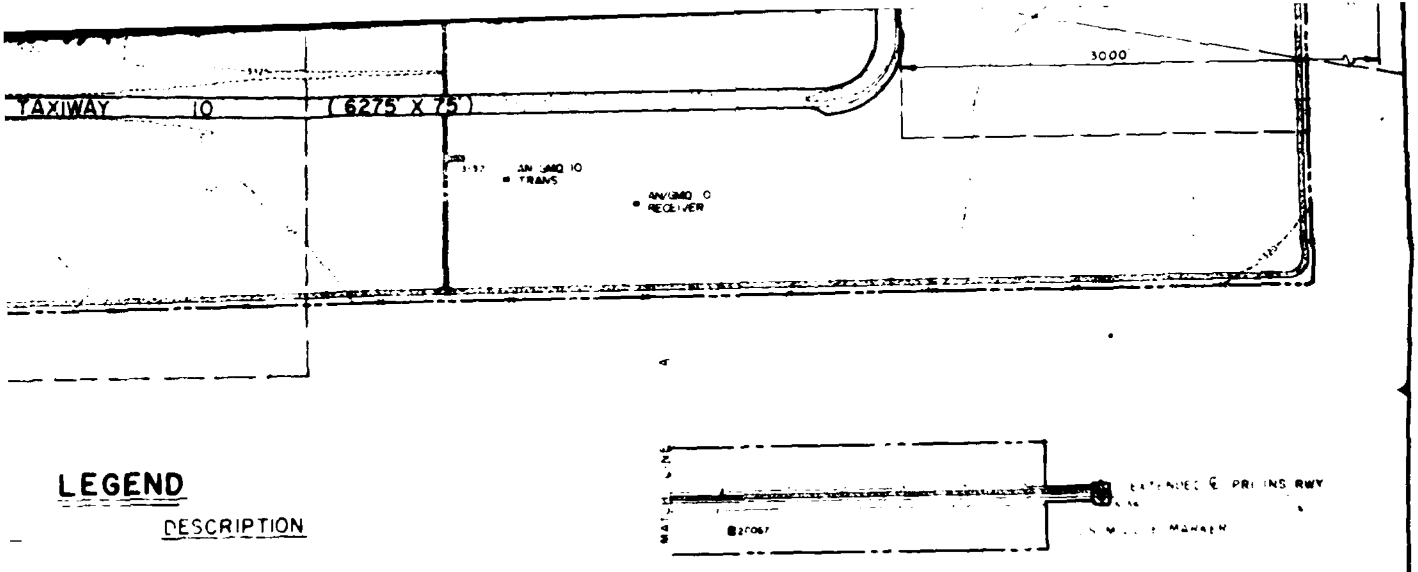

6
7
8
SUSPECT VEHICLE HOLDING AREA
SMALL ARMS RANGE
1250' CLEAR FOR INHABITED BUILDINGS
60806
SHOT FALL CLEARANCE
RUNWAY "A" (10,500' X 150')
ABANDONED
RSU NO 2
RSU NO 6
VORTAC
RUNWAY PRIMARY/INSTRUMENT (10,500' X 150')
ABANDONED
TAXIWAY 10 (6275' X 75')
TAXIWAY 1
425' X 100'
LEGEND


3
8
9
10
AREA 007
HAZARD CLASS/DIVISION 1.1 EXPLOSIVES
425 LBS MAXIMUM
1250' CLEARANCE
3000'
CLEAR
GLIDE ANGLE 1.50
RSU NO 2
RSU NO 6
TAXIWAY 11
(1395 X 75)
AN/GMQ-3 PROJECTOR
AN/GMD 15 DETECTOR
ILS LOCALIZER
ILS GLIDE SLOPE
INSTRUMENT
(X150')
AY 10 (6275' X 75')
AN/GMD 10 TRANS
AN/GMD 0 RECEIVER
E
C
D


AREA 002
SEWAGE LAKE
AVERAGE ELEVATION 3296
TAXIWAY 6 (2335' X 100')
(700' X 100')
TAXIWAY
JET ENGINE TEST CELLS
AREA 001
STATE HIGHWAY 114
TO LUBBOCK
3000'
SEWAGE DISPOSAL PLANT
PLANT
B-3
Geophysical Survey Area
Geophysical Survey 0,0 Point


RSU NO 4
RUNWAY "8" (6500' X 150')
17
TAXIWAY 3
425' X 100'
TAXIWAY 2
425' X 100'
TAXIWAY 1
425' X 100'
A / C
PARKING
APRON
AREA 009
SOFTBALL 60840
SOFT BALL
SOFTBALL 60840
SOFTBALL 60840
SEASONAL LAKE
FRENSHIP INDEPENDENT SCHOOL DIST.
STATE FM 2255
NOTE TENANT FACILITIES
FACILITY NO 10 BELONGS TO THE CITY OF LUBBOCK AND IS THE DELIVERY POINT FOR THE BASE WATER SUPPLY
FACILITY NO 440 BELONGS TO THE BASE BRANCH BANK

4 5 6 7



LEGEND

DESCRIPTION

EXISTING PERMANENT
EXISTING SEMI PERMANENT
EXISTING TEMPORARY

AIRFIELD PAVEMENT TO BE RETAINED

AIRFIELD PAVEMENT TO BE ABANDONED

STREET PAVEMENT

UNSURFACED ROADS

FENCE - UNCLASSIFIED

FENCE - CHAIN LINK

CONTOUR LINE

RAILROAD

EXISTING BOUNDARY

Figure 4-2
GEOPHYSICAL SURVEY AREAS

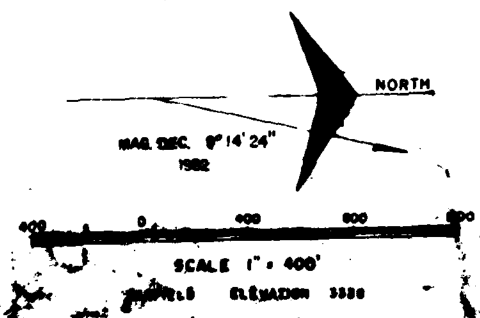
FOR OFFICIAL USE ONLY

MAY 4 1988

ZONE	DESCRIPTION	DATE	APPROVED
VAR	GENERAL REVISIONS	30SEP85	TBJ
VAR	GENERAL REVISIONS	30SEP84	EC
VAR	GENERAL REVISIONS	[illegible]	JGR
VAR	GENERAL REVISIONS	[illegible]	[illegible]

REVISIONS

APPROVED BY:
CHAIRMAN, BASE



DEPARTMENT OF THE AIR FORCE

AIR TRAINING COMMAND
BASE COMPREHENSIVE PLAN
BASIC LAYOUT PLAN
REESE AIR FORCE BASE
LUBBOCK TEXAS

SCALE: 1 INCH = 400 FT. DATE 6 MAY 1988

LUBBOCK, TEXAS

CONTRACT NO AF 41 [illegible]

9